INDIVIDUAL DIFFERENCES IN INCIDENTAL MEMORY

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BY
SADIE MYERS SHELLOW, PH. D.

Submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, in the Faculty of Philosophy, Columbia University

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Individual Differences in Incidental Memory

CHAPTER I

Introductory

The phenomenon of memory may be accounted for in two ways. In the first place we may consciously set out to learn some given material with the purpose of being able to recall it at some later time. This process is really a process of habit formation, and depends for its success on the number of repetitions, the time interval between the repetitions, the method of studying the material, and other factors shown by Ebbinghaus (11), Gates (12), and other investigators. But not all material which we recall has been learned or memorized in this way. We constantly find ourselves possessed of facts, bits of material which have come into our experience at some time and which we had never intended to remember at all. And yet there they are, sometimes standing us in good stead at a critical moment; a certain road over which we have gone only once, a face which we have seen only in passing, a telephone number which we did not expect to use again, a fact, a reference, will be recalled and we ourselves marvel at having been able to recall it. At the same time, try as we may, familiar material which we may experience every day of our lives may leave very slight impression on us and we may be totally unable to recall it. No wonder Bergson has called this second kind of memory, which appears to come and go regardless of rules, "capricious" (4).

It is this second kind of memory which is the subject matter of the present paper. It has been called "incidental" memory because it is concerned with material which is incidental to the matter which was occupying the center of attention of the subject, but which must necessarily have come into consciousness during the attention to the primary matter. In our study we shall see that the adjective "capricious" is indeed

a very apt one for describing its character, for we shall find that this memory does not only greatly vary among different individuals but in the same individual is vastly different when applied to different kinds of material. So the problem is not only concerning the functioning of incidental memory and its relation to direct memory, but also how widely individuals differ from each other in the range of incidental memory, and what variations there are within the individual concerning divers kinds of material.

The importance of this problem may not at first seem evident, but when one stops to consider one's own mental content during a single day, the preponderance in thinking over of material of so-called incidental memory, over that of direct memory of consciously learned material, will be easily apparent. It is therefore important to know how far we are able to depend upon our incidental memory for facts and how necessary memorizing is to us—whether or not the fact that we can memorize easily also means that we can feel confident that a large part of experienced material not intentionally memorized lies within reach of easy recall. And in educational work, recognizing the large part that incidental memory plays in every-day living, we see the value of having tests in order to determine the efficiency of students in recalling incidental material, and methods for improving and drilling for incidental memory.

The purpose of this study is, then:

1. To study the range of variation in a large group of subjects, as nearly homogeneous as possible, in order to eliminate such factors as race, sex, and age differences.

2. To study the variations within an individual when presented with different kinds of material.

3. To compare incidental and direct memory of individuals, in each of the experiments.

4. To discover whether or not the same relationship between recall and recognition holds true for incidental memory as has been found to hold true for direct memory.

5. To attempt to analyze by means of correlations with standard tests those processes which make for good incidental memory.

6. By analysis of introspective reports, together with objective experiments, to account for the remembering of incidental material.

Historical

Garry Myers in his "Study In Incidental Memory" (19a), published in 1913, gives a digest of all the important work done on this subject up to that date. As he says, "Only a small amount of literature bearing directly upon incidental memory has been produced....most of the experiments made heretofore have been attempts to show the unreliability of testimony and report with special reference to the judiciary" (19a). Binet in his work on "Suggestibilité" (5b) was more interested in the power of suggestion than in incidental memory as such. Nor in the case of such authors as Stern (21), Wreschner (27), Münsterberg (18), Marie Borst (7), Claparède (9), Otto Lippman (16), and even Cattell (8) and Garry Myers himself (19a), can their work be regarded as reports concerning incidental memory. There are three criticisms which apply to practically all of the work so far done under the title of "Temoignage," "Aussage," or "Incidental Memory" which make them useless as results of incidental memory. In most of the cases no care was taken to insure the perception of all the material upon which questions were to be asked later, so that the test resolved itself rather into a test of observation than of incidental memory. And, in the second place, in some cases the subjects were informed that they would later be asked to recall the material which was presented to them, and in this way the test became one of direct memory. And, finally, the tests for incidental memory have been too complicated and have often involved other factors which have greatly affected the results. It is always difficult to reduce any psychological process to a simple form, but it is only in proportion to the elimination of extraneous material that reliable results can be obtained.

Take for example some of the experiments of Münsterberg (18). In one experiment the subject was told to regard a color wheel which kept constantly turning while the experimenter did several things with his left hand such as taking out his watch, putting a pencil in his pocket, getting a cigarette; he found very few able to report on these matters. Was this due to poor incidental memory or lack of observation? Probably the latter since no precaution was taken to insure observation of these items.

Stern (21) warned his subjects that they were to be asked

concerning the items in the picture so that his test reduced itself to one of span of attention and direct memory.

Binet (5a) warned his subjects that they should be asked to describe the pictures and later he classified them according to the quality of their descriptions.

Wreschner (27) proceeded very much in the same manner as Stern but with more accuracy, still warning the subjects that questions would be asked concerning the material presented.

The work of Otto Lippman is subject to the same criticism (16).

The following pieces of work are invalidated as tests of incidental memory because of the influence of extraneous factors.

Cattell (8) in asking his subjects to estimate the time which it took to walk a certain distance was dealing quite as much with the ability to estimate time as with the memory of a definite time. Individuals differ in their ability to estimate time to such an extent that one cannot draw any conclusions concerning incidental memory from the results on this question.

Claparède (9) also introduced questions of this nature, asking his subjects to estimate distances.

Garry Myers (19a) in asking his subjects to draw the size of a dollar bill and various coins, is testing judgment and estimation of size along with the ability to reproduce one's own estimations. It is difficult for many people to reproduce the size of a dollar bill with the material directly in front of them; errors arising from this source should not be attributed to a defect in memory. In fact all his work on "Proportions and Areas" gives results for ability to estimate proportions and areas complicated by the memory factor, rather than results for incidental memory.

Isabel Wallace (24) admits that many of her questions could be answered by reasoning as well as from memory, hence there is no way to measure the memory factor.

Another criticism which applies to all questions on the remembering of familiar objects is that the original conditions of observation were not controlled nor were the experiences comparable.

In the above the writer has selected only a few of the best known pieces of work on incidental memory for criticism, but

practically all of the early work is subject to one of these three objections.

There have been, however, a few pieces of work to which the above objections cannot be made.

In the work of Garry Myers (19a) both the experiment on "incidental memory for words" and the so-called "letter-square" test are free from criticism and are both excellent tests for incidental memory. In the first mentioned, the test for "incidental memory for words," the procedure was as follows: the subjects were told that they were to be given a spelling test and that they must write the words as quickly as possible. Practice in writing figures was first given in order to accustom the subjects to write quickly. Then the words were given in the following order: "pickle, angel, dirty, busy, onion, women." The subjects were then given the signal to turn, and were asked to write from memory the list of words in the order in which they were given as far as it was possible. This experiment is a true test of incidental memory, for care was taken that the material which was later to be recalled was observed by the students, and the attention was directed to a problem which did not suggest that the material to be asked for later should be learned for recall; that is, the main problem was one of spelling, but in order to spell the words it was necessary that they be attended to, hence conditions were equalized from an objective point of view for all of the subjects. In order to study the effect of the time interval, various groups were used,—one group was tested half an hour after the original presentation of the words, other groups at intervals of three and a half hours, four and a half hours, six hours and seven days.

The following results were obtained. "The best records for the number of words reproduced and for general efficiency were secured immediately after the stimuli were given, and much better when the subject knew that the words and numerals were to be reproduced than when the memory was incidental." In comparing long with short lists, he found that the per cent for the short lists of words remembered was about the same as for the long lists. In studying differences according to age and education, he found that "there is practically no difference between the performance of grammar school children and college men in immediate recall of six

words but, after an interval of time, there is a marked decrease in efficiency from the high school to the fourth grades." In studying sex differences, he found that "the females are markedly superior to the males for the average number of words remembered and for average efficiency." "There is no correlation between the time required in recall and the amount recalled."

In the "letter-square" test, the material consisted of a board which was covered with brown paper. On this was pasted a sheet of highly saturated yellow paper with letters printed on it in bright red. There was a surrounding border of black. This board was held up before the group of students and the task given them was to count the O's on the yellow paper, so placed that it was necessary for them to examine all of the other letters to make sure there were no O's. The subjects were later questioned as to the color of the paper on which the letters were printed, the color of the letters, the color of the border, what other letters were on the paper besides the O's and how many lines of letters there were.

The results of this test were: many failed entirely to observe the border, very few letters were recalled, not many recognized, and "comparatively few were reproduced in the attempt to reconstruct the letter-square." From his results he draws the following generalization which is applicable to all material used in incidental memory tests: "the perception of an object of sensation, to the extent that it is recognized, merely as not being the object sought for, gives no assurance that the incidental elements are perceived with any degree of accuracy. Furthermore, the fact that an object falls within the central field of vision does not insure the perception of the object." Colors he found to be fairly well remembered, but often assigned to the wrong part of the stimulus object.

Kirkpatrick (15b) in his study in memorizing vs. incidental memory, attacked the problem in a unique manner. His problem was: what is the best way to gain facility in using the multiplication table? Is it more efficient to memorize it and then apply it to problems, or by using it, to learn it by means of incidental memory? Both methods were tried out on different groups; in one, the problem was first the memorizing of the table, in the other, it was the solving of the problems without memorizing the table but referring to it whenever neces-

sary. In a third group he tried a combination of both methods. The results averaged better for the practiced group (that is the group which learned the tables by using them) than for the memory group. He concluded that the memorizing apart from use was the poorest method.

Isabel Wallace (24) used as her material an illustrated lecture on Hiawatha. Four weeks later she questioned the subjects concerning the lecture. The time interval was very long and the questions were not always well chosen since reason as well as memory could be applied to some of them. She questioned her subjects as to the kind of weather they had on the day of the lecture, the color of the suit of the lecturer (which might well have not been noticed by most of the students), the subject matter of the lecture, etc.

Perhaps the best "incident" test is that of Clapārède, who on a certain holiday had men in masquerade costume come before the class and have words with him. The event was so unusual that all of the students were interested. They did not know that they would later be required to give an account of the performance. Many of the questions asked later could not be considered fair questions, but a few were very good. Several masks were shown the class and they were asked to identify the one worn by the masquerader, also to describe his costume. Claparède found that the costume was better remembered than most of the incidents, and that what he calls memorabilité (the quality an object has for impressing itself upon the memory) was greatest for colors.

Although Whipple has reduced many of the old experiments, especially those of Binet, to more scientific procedure, we still find the experiments on Incidental Memory in his Manual (25b) complicated by the judgment factor.

In an article (25a) Whipple discusses the factors upon which results on incidental memory are dependent. He includes kind of material, age of subject, sex, intelligence, form of report, exposure time, choice of questions, method of grading, and effect of practice. In the present study the aim has been to keep all of those factors constant so far as possible for all the subjects.

The subject of individual differences would require a volume for reviewing. Practically all experimental work concerns itself with the variability of a group and norms are

worked out on the basis of large distributions. The variation, moreover, within the individual himself, for different processes, has also called forth a great amount of discussion and experimentation. It is at the basis of the well known controversy over the question whether or not Intelligence is a unit. (23b). If there were found to be high positive correlation between the various processes of given individuals, one would be led to suspect that there is a unit factor, and that the various processes are but different expressions of it. But experimentation has shown that the correlations, although for the most part positive, are low (23b), and that individuals vary greatly in their abilities along divers lines. Not only has this been found true for the large coarsely grouped processes, such as perception, judgment, memory and the like, but within these processes individuals have been found to differ exceedingly in accordance with a vast number of changing conditions, as for example the time of day (12), the kind of material presented (28), (3), the length of the interval (in the case of memory experiments) (22a), and many other factors.

F. Bennett (3) in investigating the correlation between immediate and mediate retention for auditory and visual presentation of various sorts of material, found that the correlations ranged from $-.78$ to $+.90$. Great differences were found between individuals and also the differences within the individual for various sorts of material, and different methods of presentation were large.

In her work on Recognition and Recall (1) E. M. Achilles states that "earlier investigators have shown that those who recall one kind of material well may not recall another kind well. The (present) data confirm the results of previous investigators. The coefficients vary but there is a tendency for them to be positive rather than negative." In the case of recognition she says, "The correlation between recognition of different materials is low. The person who recognizes one material well may or may not recognize another material well." "Between recall of different materials the coefficient of correlation for adult groups are $+.35$ and $+.27$ and between the recognition of different materials $+.37$ and $+.28$.

Cattell (23a) perhaps was the first to work at this problem systematically, in his detailed examination of College Freshmen.

As a side problem it was suggested that the writer study the relation between recognition and recall for incidental material. The subject has been very well covered in the case of direct recognition and recall by E. M. Achilles (1), and also some results are given in the same paper on "undetermined recognition and recall," in which the term "undetermined" is used in the same sense as the term "incidental" in this paper. In the paper referred to above, the most important recent works on recognition and recall are reviewed, and the following are a few of the conclusions drawn from the careful experimental work done by the author.

1. "More items are recognized than recalled. The difference in recall and recognition memory is in part dependent on the richness of associations formed."

2. "Determined recall differs from undetermined recall more than determined recognition differs from undetermined recognition."

3. "The difference between recall and recognition is greater when the subjects did not know that their memory was going to be tested than when they did know."

4. "The correlation between the recognition of different materials is about the same as the correlation between the recall of different materials."

To sum up these four points, one might say that,—"recall depends on previous intentional memorizing more than recognition does, the preparation for recognition being an easier response that is likely to occur unintentionally, and the preparation for recall a harder process that is unlikely to occur unintentionally."

CHAPTER II

Statement of the Problem and Description of the Tests

The problem, then, in devising tests for incidental memory is four-fold.

1. The test must be simple. Extraneous material must be eliminated as far as possible and great care must be taken to avoid involving complex processes other than memory, which might invalidate the results.

2. Perception of the material later to be recalled must be assured.

3. A diverting direction or "aufgabe" must be given which would occupy the center of attention in such a way that direct learning of the material used for incidental memory may be avoided.

4. The experiments must be such as to lend themselves to objective scoring.

In the following description of the experiments used, the manner in which each of the tests meets these requirements will be pointed out.

Magazine Test

First Series

Material used. Twelve magazines, no one of which was an issue of the current year. Each had a cover distinctly different from any of the others, and the pictures were easily seen, large and covering the entire page. Below is a list of the magazines and a brief description of the picture on each.

1. The Country Gentleman	A bear on a tree with a porcupine coming up after him. Background orange, animals black.
2. The Red Book	Usual cover with girl's head, brunette. Black hair against white background, red border around edge.
3. Farm and Fireside	Picture of a country doctor examining a small boy. (Humorous).

4. American	(Cover *only* shown). Picture of a girl looking into a hand mirror with reflection of face shown in the picture.
5. Mothers' Magazine	Mother and child examining Christmas package.
6. Vogue	"Millinery Number" in large type across top. Ladies in green and pink trying on hats.
7. Saturday Evening Post ..	Old-fashioned girl in picture frame.
8. Current Opinion	No picture. Cover obviously torn, bottom edge off entirely.
9. To-day's Housewife	Girl in bathing suit with man holding bright green umbrella over her.
10. World's Work	Red, white and blue design, eagle and shield. Heading in large type: "United States and Germany."
11. House and Garden	Old-fashioned gentleman and lady making a call. He has his hand on the door knocker.
12. McClure's	A group of bathing girls.

Presentation of Material

Directions:

"I am going to show you a number of magazines. Look at each carefully and try to remember the name and the order in which it came. At the end of the hour I am going to ask you to write down the names of as many magazines as you can remember as nearly in order as possible. Please do not ask any questions or make any remarks during the experiment."

Part A. Direct Recall

After an interval of twenty minutes during which time the class was busy at its regular academic work, the examiner returned to the room, passed out folded paper and gave these directions: "Write your name, class, the number of this course, and the date on the outside sheet, and number from 1 to 12. (The examiner illustrated with a piece of paper before the class, pointing to the location of the name and the edge along which the subjects should place the numbers). "Opposite number 1 write down the name of the first magazine you were shown, opposite number 2, the second and so on.

Write as many as you can, each in its correct position as far as possible."

The time allowed for direct recall was two minutes.

Part B. Recognition, Direct for Names, Incidental for Pictures. (This test also served as a second presentation).

A second series of magazines was now shown the subjects. This series included all of the magazines shown at the beginning of the hour and twelve others, many of which were identical in name but had different pictures. This recognition test was given to compare recognition with recall of the names of the magazines, and (the most important reason) to insure the subjects' looking at the pictures on each of the magazines. The directions given were: "Now I am going to show you another series which will contain some of the same magazines which you saw before and also some other magazines. You are to answer two questions in regard to each magazine, first whether it has the same name as one in the previous series, and second whether it has the same picture as the one of that name in the previous series. Number from 1 to 24. Opposite each number write A and B like this: A / B (examiner illustrated on board). Opposite the A's write "yes" or "no" according to whether or not a magazine of that same *name* was shown you before; and opposite B write "yes" or "no" according to whether or not a cover with that picture was shown you before. To illustrate, suppose I show you a magazine; it has the same name as one in the first series, but a different picture, you would write: A Yes / B No (Illustrated on blackboard). Any questions?

Each magazine was exposed for ten seconds.

Note: The exposure time both for the first and the second parts of this test, and for all other tests in which exposure times are stated were worked out on small groups and a time long enough to insure perception of each member of the group, selected.

Part C. Incidental Recall (based upon the two previous presentations).

After the answers to Part B had been written, the subjects were next instructed to refold their papers so that both of the

used pages were on the inside, and the blank pages on the outside. Part C contained the following Incidental Memory questions:

1. Describe in a few words the picture on the Saturday Evening Post.
2. Of which magazine were you shown a cover only?
3. What was the picture on the Country Gentleman?
4. Which magazine had the picture of a girl's face in a mirror?
5. Which magazine had the picture of some bathing girls?
6. What was the picture on Farm and Fireside?
7. Which number of Vogue were you shown? ("Millinery Number" was written across the top in larger letters than "Vogue").
8. From which cover was there a piece torn from the bottom right hand corner?
9. Describe the design and the colors of the World's Work cover.
10. Which magazine had the picture of a man and a woman dressed in old-fashioned costume, knocking at a door?
11. What was the picture on To-day's Housewife?
12. Which magazine had some writing in ink on the upper right hand corner?
13. Was the girl of the Red Book a brunette or blond? If your answer is a guess, please mark "guess" after it.
14. On which cover was there a picture of a man holding an umbrella over a girl dressed in a bathing suit?
15. What color was the umbrella?
16. Which magazine had the picture of a country doctor and a small boy?
17. Of which magazine were you told the name as it was shown to you?

The above experiment meets the requirements originally stated for a test in incidental memory. It is simple, in that it does not involve judgment or reasoning ability primarily, but is a test purely of memory. Observation of the material later to be recalled through incidental memory is insured by the recognition part of the test which comes before the incidental memory recall. Here the subject must attend to both the pictures and the titles, and at the same time she does not know that she will later be asked to describe the pictures so

has no incentive for learning them. A diverting "aufgabe" is given the subject which occupies the center of her attention in trying to learn the names of the magazines in order in a short time, and at the same time it is necessary for her to observe the covers of the magazines.

Scoring

In the direct memory two different scores were given, the first (to be designated hereafter as IA, or Magazine, Direct Memory) based on the per cent remembered of the total number given regardless of order, and the second a score representing the ability to recall the magazines in correct order. This second score (IB, or Magazine, Direct Recall, order) was obtained by correlating (Spearman foot-rule) the given with the true order and omitting in the series of the true order those omitted by the given order. The answers to the incidental questions (IC, or Magazine, Incidental Memory) were graded one point each, if correct, and zero if incorrect. The percentage of correct answers of the whole number represented the final score for the incidental part of the test. No account was taken of the wrong answers since the object was to measure quantity of correct material rather than reliability of testimony. The recognition score (Magazine Recognition) is the number right.

Series II

While the results from the above test brought to light individual differences, the series was too short to show group variabilities in comparing direct with Incidental Memory. In order to get a somewhat larger distribution of scores the test was modified considerably and tried out on several new groups.

The number of magazines was increased to 15, and the presentation was as follows:

Group 1. Directions: "I am going to show you a series of magazine covers. I want to see how well you can remember their names in order. I am not going to signal you when I change the magazine, so watch carefully. Do not write anything until I tell you to do so. Just see how many of these names you can remember in order as far as possible."

Each magazine was exposed for fifteen seconds.

Part A. Direct Recall of Names in Order

After all of the magazines had been shown, the subjects were instructed to write their names, the date, their year and the number of the course, and to number from 1 to 15 along the folded edge of the paper (as before). They were then told to write the names of the magazines in order so far as possible.

Part B. Incidental Memory of Pictures

Directions: "Now turn your papers over. Write Part B at the top of the page. I am going to call off the names of the magazines in mixed order, and see how well you can remember the pictures which went with each of the covers. As soon as I give you the name of a magazine, write a description of the cover in as few words as possible, yet sufficient to distinguish it from the others. Ready. Number from 1 to 15. Opposite Number 1 describe the cover of Life, Number 2—Vogue, etc."

After the entire list of fifteen had been given the subjects were told to refold their papers as in Series I.

Part C. Incidental Memory for Order

Directions: "Now I am going to show you the series of covers again. This time see how well you can remember what picture goes with each magazine." Each cover was exposed for ten seconds, and the original order was reversed. After the completion of exposing the series, the same procedure as for Part A of this series was repeated.

Part D. Direct Memory for Pictures

Same procedure as for Part B, with order reversed.

Group 2. Direct Memory of Pictures and Incidental Memory of Order

The procedure and instructions were the same for this group as for group 1, except that the order of the parts were interchanged so that the directions at the original presentation instructed the subjects to try to remember the pictures which went with each of the magazines, and the order was incidental. The series was then repeated as in the first group with the order reversed and the subjects instructed now to try to remember the names in order.

Group 3. Control Group. Pictures and Names in Order Both Direct

Only one presentation was given to this group. The subjects were instructed to try to remember the names of the magazines in order and also what picture went with each magazine.

Part A. Names in order, direct recall.

Part B. Pictures with names, direct recall.

Colors and Letters Test

Materials: (a) Shapes of various sizes cut out of cardboard and covered with highly saturated colored paper, a different color for each shape. These were all mounted on one large piece of white cardboard. Directly under each shape was a black letter (Dennison's standard letters), an inch high.

(b) A second set of objects, same shape as first, separately mounted on white cardboard pieces 4½ x 6½ inches. All of these shapes were of a uniform color, gray, and had no letters beneath them.

(c) A third set in which each shape was represented in four colors, only one of which was the original color used in the first set. There were no letters with this test.

(d) A set of letters arranged in groups of fours, each group containing two letters which had not been originally used and two letters used in the first set.

Procedure:

The experimenter took set Number 1, the large white cardboard with the shapes of various colors, each with its own letters and held it up in such a position that everyone could see all the shapes and letters plainly. Before exposing the card, the following directions were given:

"This is a test for estimating the area of different colored objects. Look at each one of the objects and judge which has the largest area. After you have found the largest, write No, 1, and the letter which is directly under the object, then find the next largest, and so on. Arrange as many as you have time for in this way. For example, should you decide that X is the largest, you would write, 1-X, and that G is the next largest, 2-G, and so on. You will have three minutes. Ready, begin."

Part I. Incidental Memory for Colors and Letters

After an interval of twenty minutes Set Number 2 was shown—the set containing the objects cut out of gray cardboard, with no other colors and no letters.

Directions: "Write Part I. Number from 1 to 10. (Examiner holds up one of the gray cards). What color was the object which had this size and shape? Write the color opposite number 1. What letter was under it? Write the letter opposite the color. Number 2, write the color and then the letter, etc."

Each card was exposed fifteen seconds.

Part II. Recognition for Colors

When the above had been completed, the examiner took the third set of cards, containing the same shapes, each cut out of four different colors, one of which was the original color, and mounted on white cardboard 4½ x 6½ inches. These four cards were held together by clips, and the object in all four colors presented at once.

Directions: "Write Part II and number from 1 to 10."

"Now you will be shown the same shapes which you saw before, each one cut out of four different colors. Pick out the color which you recognize to have belonged to that shape in the first part of the experiment and write the name of that color opposite number one, for the first group, opposite number two for the second, and so on." Each set was exposed for ten seconds.

Part III. Recognition for Letters

The final part of this experiment concerned itself with the recognition of letters. Here a set of cards in which each shape again is shown with its original color and a set of four letters, one of which is the correct letter, one a letter used in the original set but not belonging to that shape and two letters which were not used in the set at all.

Directions: "Turn over your papers and write Part III. (Examiner demonstrates method of turning papers). Number from 1 to 10. Now I am going to show you the same objects cut out in their proper colors and see if you can recognize what letter belonged to each. I will hold up a card with four letters on it, select the one which you recognize as having

belonged to the first object and write that letter opposite number 1. Do the same for the second set, and so on. Be sure to keep them in order. Ready. Set Number 1," etc.

The above experiment is the most thorough of all the experiments tried out. Because the material was so simple it was easy to use it in different ways. By giving as the problem the estimation of sizes of objects and their arrangement according to size, the attention was entirely directed away from memorizing colors or letters, and the questions on this material were clearly incidental. At the same time the subjects were forced to associate the letter with the shape since they must designate the shape by its letter, and the shapes were entirely covered with the bright colored paper so that it was impossible to see them without seeing the colors.

Scoring

In scoring the first part, one point was given for each item correctly remembered; the colors and the letters were scored separately. The same method of scoring was carried out throughout this test. Since the object in view was to discover individual differences both within a group and within the individual himself and since all the scores were later expressed in terms of average deviations from the average, there was no necessity for using a more complicated method of scoring in order to eliminate the chance factor in those cases where the chances were one out of four for guessing. Had the object been to measure the quantity of incidental memory, the problem of scoring would have been a very difficult one, but here, for purposes of measuring the relative positions of various individuals in a group, a simple method which is applied equally to all cases is adequate. Any other method of scoring which would be fine enough to distribute a group sufficiently to show large deviations from the average, would do equally well in the present type of experiment.

From the above procedure it can be seen that material was obtained which would distribute the same group according to incidental memory for colors and letters, in both recall and recognition. At a later time one of the groups to which this experiment had been given was tested out for direct memory for colors and letters in the following way:

Part IV. Direct Memory for Colors and Letters

A new set of material was prepared, the shapes and colors were different from the original set, but all other conditions were constant. The group was told that this time the experimenter wished to test them for direct memory for colors and letters and would show them a set of colored shapes each with its own letter just as before. They were to try to learn the letters and colors which went with each shape. After an interval equivalent to the one used in the previous experiment, viz., twenty minutes, recall of the colors and letters was asked for, in the same manner as before, by holding up the object cut out of gray cardboard and asking the subject to write the letter and color which belonged to each object. In this way it was possible to compare the direct memory for letters and colors with the indirect or incidental memory of the same subjects for material, which though not identical, was sufficiently similar to give reliable results.

Note on Colors and Letters Chart

Objection might be made to the arrangement of the colors and the position of the various forms. There would be justification for a criticism of the arrangement of the colors were the object of the experiment to test memory of colors as such. But here where the emphasis is on the individual and his relation to his group, such an objection would have no weight since even though certain colors may gain by their juxtaposition with others, and certain other colors be at a disadvantage, nevertheless, the error would be constant and should influence all of the members of the group alike. The colors on the card itself were of sufficiently different hue as to be easily designated by the subjects. In the case of the two blues, in practically every case the subject qualified her answer by giving either "light blue" or "dark blue." Where a mistake was made in which the shades were interchanged, no credit was given, and the error considered as grave as though a wrong color had been assigned. This rule was carried out because of the fact that the light blue was very pale, and the dark blue almost a navy blue.

The same defense holds true for the connection of the colors with the shapes. As it happened, the yellow shape seemed to have had the advantage over the others. However, this ad-

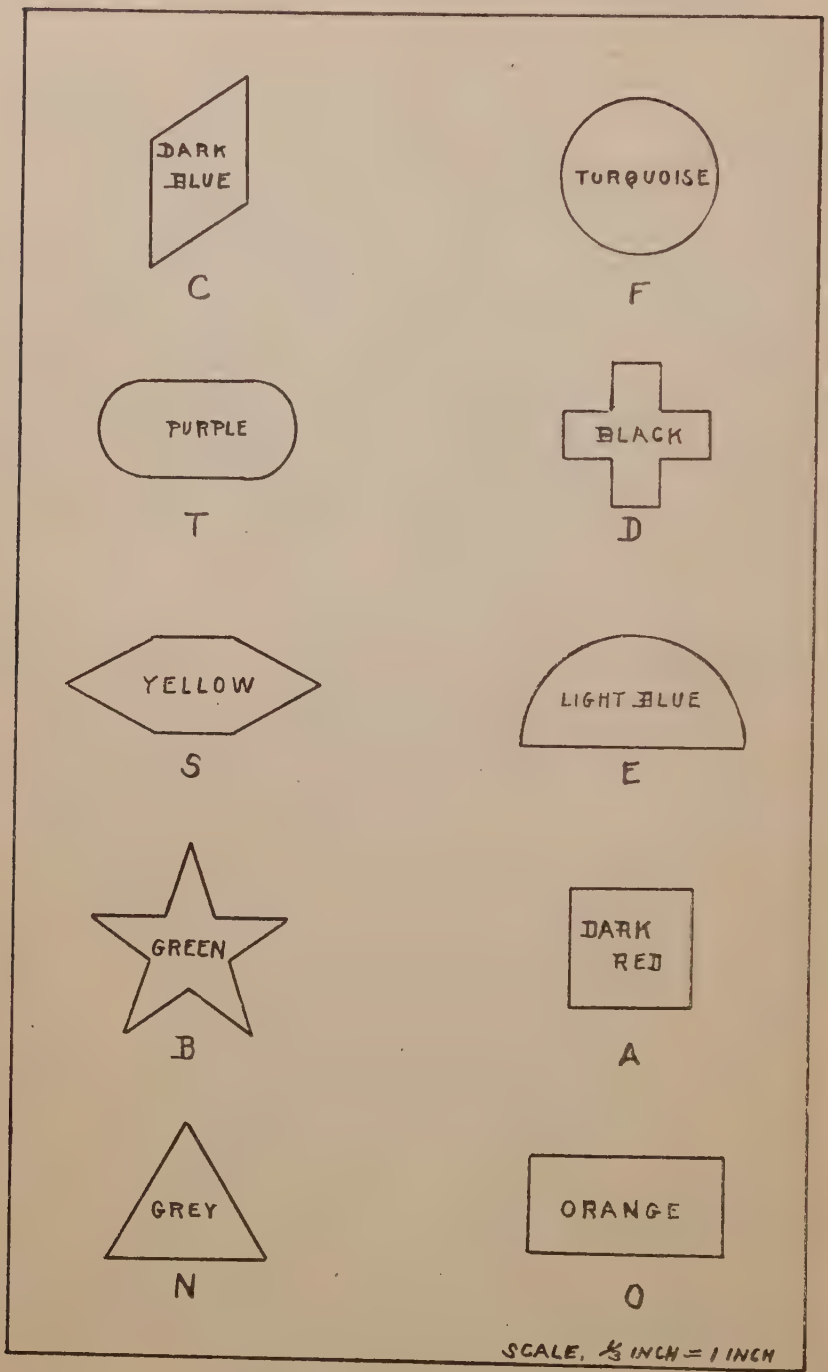

Chart I—Colors and Letters Test

vantage should have been the same for all the subjects, none of whom were color blind, and would not interfere with the ranking according to percentiles or A.D.'s. An interesting study could be made in this connection of the material, and the colors and shapes most easily remembered, discovered. But this is another problem.

Colors and Forms Test

In the preceding experiment the results for the remembering of letters were so low that an additional experiment was tried with the colors and figures alone.

Material: A card containing twelve shapes of various colors, arranged in three rows of four each. A set of twelve cards each with one of the shapes in gray pasted on it. A set of cards each containing a square of one of the colors of the original large card.

Group 1. Presentation: sheets of paper were passed out, each sheet having a square divided into twelve parts drawn upon it.

Directions: "I am going to try a little experiment to see how well you can remember where things are that you see. I am going to show you a large chart like this. (The chart was held up before the class with the blank side toward the class. Upon this side was drawn a large oblong divided into twelve parts corresponding to the twelve sections on the other side of the chart.) In each of these squares there will be an object —Each will have a different shape. I am going to let you look at the card for one minute and then I am going to show you each of the shapes and give each a number and ask you to write the number in the square where that shape was on the chart. For example, the first object I show you will be Number 1. If that shape was in this place (indicating one of the squares) then put a Number 1 in that square on your paper, like this, if it was in this square (indicating another square) write Number 1 here. Do not write any numbers until I tell you to do so. Are there any questions? Be sure to try to remember the shape of each object and its position on the chart."

The chart was exposed for one minute.

Part I. Direct Memory for Shapes, Incidental for Color

"Write your name, age, grade, school. Now I am going to show you the objects and you are to put the numbers in the squares where the object was on the chart. I also want to see if you can remember colors. So after each object I am going to show you a color, and see if you can remember in which square that color was. Each color will have a letter, the first will be A, the next B, and so on. Already, (holding up first card with shape in gray).

"Number 1. Put a 1 in the square where this object was on the chart.

"Ready. Color A. Put an A in the square where this color was on the chart.

"Number 2. Color B, etc."

Each card was exposed fifteen seconds.

Note: the shapes and colors were mixed so that no color followed the shape to which it belonged.

Part II. Direct Memory for Colors, Incidental for Shapes

"Turn the page over. Now it was not quite fair for me to ask you about the colors when I told you only about the shapes. So this time I am going to show you the chart again, and I want to see how well you can remember where the colors are. We will do just as before. Look carefully at the chart until I take it away, and then I will ask you to put letters in the squares where the different colors were."

The chart was exposed 30 seconds. The same procedure as in Part I was carried out, with the order reversed.

Group 2

In this group the presentation was changed so that the subjects were first instructed to remember the colors; thus for Part I the colors would be direct and the forms incidental, and for Part II the colors incidental and the forms direct.

Group 3. Control Group

Presentation: Same as above with wording changed so that subjects are instructed to try to remember first where each shape belonged on the chart, and second where each color belonged.

Part I. Direct Memory for Position of Objects and Colors

The procedure was the same as for the first part of the preceding groups.

Part II. Incidental Memory for Colors of Forms and Forms of Colors.

Preliminary drill: In order that there might be no doubt concerning the names of the colors, each color was held up before the class, and the class was asked to tell the name of that color. For the two figured patterns special names were given by the experimenter. Then several of the subjects were asked to draw the figures on the board in order to make sure that the shapes were easily drawn. It was pointed out that they must be careful to distinguish between the square and the oblong in their drawings.

"Now I am going to show you the small cards again. Whenever I show you a gray shape I will give it a letter and you are to write the name of the color which that shape was on the big chart. When I show you a color, I will give it a number. You will write the number and draw the shape which had that color on our big chart. Is that clear? Ready. Number 1. Draw the shape that had this color. A. Write the name of the color which this shape was. Number 2. Shape. B. Color," etc.

Each card was exposed fifteen seconds.

Scoring: The number right was recorded in each case of the above tests.

Paragraph Test

The type of material here presented is very different from that of any of the preceding tests. A paragraph from a very unfamiliar book (The Romance of Leonardo Da Vinci, by Dmitri Merejkowski) was selected, principally for its wealth of detailed description. The paragraph was presented as follows with the directions printed at the top. Each subject had her own sheet.

Four minutes was allowed for the subjects to read through the paragraph. (This time has been found ample for the slow reader to read it through twice). While some of the rapid readers probably were able to begin on a third reading, at

least each subject spent the same amount of time on the paragraph, and in the long run the advantages were probably equal.

Part I. Recall

After an interval of twenty minutes the examiner returned to the room with Part I. On this sheet, also mimeographed so that each subject had her own copy, were arranged thirty questions. They were divided roughly into three groups: (A), those which had directly to do with the description of Savanarola—the direct memory part of the test, (B), those which had to do with the general background of the picture, (C), which so far as the examiner could make them, were concerned with incidental material, such as type, paragraphing and so on. It was thought by this devise to be able to test the same group in three different grades of memory, over the same material.

Part II. Recognition

Immediately after answering the questions of Part I, the subjects were given the questions of Part II. This third sheet contained the same questions as the second but revised so that it became a recognition test rather than one purely of recall. Ten minutes was allowed for the recall and five minutes for the recognition.

Here we have the attention diverted from the incidental material by setting the problem of memorizing a selected part of the whole material given.

In scoring Part I, the questions were divided into three grades: (A), those dealing with direct memory, questions 1 through 11, (B), intermediate, 11 through 19, and (C) Incidental material. For each part a sum of twenty points was assigned so that the totals could be equal; the points were scored according to items remembered, and each point expressed in a fraction of twenty.

Four of the questions did not lend themselves to the recognition form and had to be omitted, reducing the number to twenty-six. These were divided as follows: (A)—1 through 11, (B)—11 through 21 and (C)—21 through 26.

Direct Memory for Entire Passage

This same paragraph was given to another group as a direct memory test. The subjects were given the following directions: "I am going to give you a paragraph to read and then ask you certain questions about it at the end of the hour. I will read the questions to you now, listen carefully so that you may use them as a guide in studying the paragraph. Ask no questions. Make no notes." The time for the reading was five minutes including the reading of the questions, which left this group the same time for reading the paragraph as the first group had been given. The interval between the reading and the answering of the questions was the same as in the former case.

The reason for this additional experiment was to be able to compare the results especially on sections (B) and (C) when the attention was directed to the points to be remembered with the results when these two groups of material were incidental to the main problem.

Read this passage *through twice* endeavoring to get a clear picture of Savanarola so that you can describe him in detail at the end of the hour. Make no notes. Ask no questions. Please do not discuss this test after you leave the class, either among yourselves, or especially with students who have not taken it.

\+ + + + +

"Giovanni went to the cathedral, where that morning, the 14th of April, 1494, Fra Girolama Savanarola was to preach. As he entered, the last notes of the organ were dying away under the resounding arches of Santa Maria del Fiore. The throng had filled the church with suffocating heat and the low rustlings of unceasing small movements. Men, women, and children were separated from each other by drawn curtains. Under the arches, slender and narrow like arrow heads, deep gloom and mystery reigned as in a sleeping forest. The rays of sunlight, refracted by brilliantly colored glass, fell in rainbow hues upon the congregation and upon the grey marble of the pillars. The semi-darkness surrounding the altar was broken by the glare of candles. Mass was over and the crowd was awaiting the preacher. All looks were fixed on the wooden pulpit. Giovanni saw a man in bleck and white Domincan habit girdled with a rope, who slowly ascended the pulpit-stair and removed his cowl. His face was emaciated and yellow as wax, his lips thick, his nose acquline, his forehead low. His left hand fell weakly on the desk, his right hand he raised clutching the crucifix; and silently with burning eyes he looked

upon the trembling and expectant crowd. Profound silence reigned, in which each man could hear the beating of his own heart. The eyes of the monk glowed increasingly, till they were like fiery coals; but he still kept silence, and the strain of waiting became unendurable. It seemed that in another moment the crowd would burst into screams."

From *"The Romance of Leonardo Da Vinci"*

by DMITRI MEREJKOWSKI.

PART I. RECALL

Questions on passage read. Please answer each question to the best of your ability. Take them in order, do as many as you can. You will have 10 minutes.

1. What was the full name of the man described in the passage?
2. What color was his habit?
3. What was girdled around him?
4. What words were used to describe his face?
5. What adjective was used to describe his lips?
6. What adjective was used to describe his nose?
7. What adjective was used to describe his forehead?
8. Describe the position of his right hand.
9. Describe the position of his left hand.
10. What did he hold in one hand?
11. What were his eyes likened to?
12. In what cathedral did he preach?
13. What was the date? (date of day, month and year)
14. How were the men, women and children arranged?
15. What time of day was it?
16. What were the arches likened to?
17. Who else was mentioned by name in the passage beside the chief character?
18. What color were the pillars?
19. What kind of a pulpit was it?
20. From what book was the selection taken?
21. Who wrote the book?
22. How many paragraphs were quoted?
23. Was the first word indented?
24. Were there quotation marks around the sentence?
25. In one of the words a letter was omitted, which word was it?
26. One word was misspelled, which word was it?
27. What typographical symbol was used to separate the directions from the selection?
28. Complete this sentence from the selection, "gloom and mystery reigned as in a ....."
29. What words were underlined in the directions?

30. Was the selection single spaced, (as these directions are) or double spaced, (as this line is in respect to the one above it)?

Leave this paper at the desk as you go out.

PLEASE DO NOT DISCUSS THE TEST AFTER YOU LEAVE THE ROOM.

PART II. RECOGNITION

Name ..... Class ..... Date ..... Course No. ....

The questions which you answered before are now given again, each with several possible answers. *Underline* the answer which you recognize as being correct in the case of each.

1. Full name of man described in passage: Girolma Boltraffio; Giovanni Savanarola; Boltraffio Giovanni; Girolama Savanarola.
2. Color of habit: black; black and white; brown; brown and white.
3. Girdled around him was: a silk cord; rope; cord; belt.
4. Words used to describe face: white; pale; emaciated; yellow; like wax; like ashes.
5. Adjective used to describe lips: pale; thin; thick; red.
6. Adjective used to describe nose: pointed; Roman; aquiline; large.
7. Adjective used to describe forehead: high; low; broad; receding.
8. Position of right hand: raised; resting on pulpit; hanging by side; not stated in passage.
9. Position of left hand: "clutching robe"; "fell weakly on desk"; "held high"; "trembling with fear."
10. Held in one hand: Book; Bible; Crucifix; Torch.
11. Eyes likened to: cool clear pools; flashing daggers; burning coals; cold grey steel.
12. Cathedral in which he preached: Santa Lucia Grazia; The Cathedral of the Holy Virgin; Santa Maria Del Fiore; Santa Delphia Maria.
13. The date was: April; March; January; August; 1st; 20th; 14th; 19th; 1865; 1494; 1449; 1576; 1467; 1496.
14. Arrangement of men, women, and children: all sat together; men upstairs, women downstairs; separated by drawn curtains; separated by carved partitions.
15. Time of day: morning, afternoon, evening, night.
16. Arches likened to: "spears"; "arrow heads"; "pointed weapons"; "domes."
17. Other names mentioned in passage: Giovanetti; Giovanni; Bendetto; Marcello; Boltraffio.
18. Color of pillars; white; rose; grey; yellow.
19. Kind of pulpit: iron; wooden; carved; stone.

20. Name of Book: Life of Savanarola; Reminiscences of the 15th Century; Romance of Leonardo Da Vinci; Memoirs of Michael Angelo.
21. Author of Book: Dostoyevski; Merejkowski; Meredetti; Anatole France.
22. Word in passage with omitted letter: clutchng; Domincan; surround; whre.
23. Misspelled word in passage: unendurible; beeting; bleck; whech.
24. Symbol used to separate directions from selection . . . = = + + - - -
25. "....gloom and mystery reigned as in a": dark dungeon; silent tomb; sleeping forest; magic wood.
26. Words underlined in directions: *Please remember; through twice; read carefully; answer questions.*

Please do not discuss this test after leaving the room.

Subway Sun Test

Material: "Subway Sun" sheets, numbers 5 and 6 from New York Subway. The sheet was fastened to a cardboard where it could be seen easily by all the subjects.

Procedure: The sheet was fastened to a cardboard where it could be seen easily by all the subjects.

Directions: "I am going to show you an advertisement. From what you know of psychology, I want you to criticise this, determining whether or not it is a good advertisement and state your reasons. The Subway of New York City has these signs in every car; they are changed about once a month. The Subway Company has been trying to change the fares and started this campaign with the purpose of informing the public of the service and efficiency of the Subway System. Look at the advertisement as a whole, read it through carefully, do not skip or overlook any of it. Take no notes. At the end of the hour you will be asked for your criticism."

The sheet was exposed for one minute.

After an interval of twenty minutes the following questions were asked:

"Write your names, class, date and the number of this course. Write Part I at the top of the page. Was the advertisement a poor one? Support your opinion in a few words." Two minutes were allowed for answering this question.

"Turn your papers and write Part II at the top of the page. Answer each of the following questions to the best of your ability, please do not ask any questions.

(Questions for Number 5).

1. What words were underlined?
2. With what was the transportation system compared?
3. How many times a year, on the average, did New Yorkers ride in 1906?
4. What was the average number of times they rode last year? (1920).
5. What was the title of the article?
6. What was the number of the article?
7. What was the date, month and year on the advertisement?
8. What was the motto in the upper right hand corner?
9. What was the picture in the center at the top of the sheet?

This experiment was the poorest one tried for many reasons. In the first place there were not enough questions which could be asked concerning the subject matter, which would lend themselves to objective scoring. And in the second place even with the above selection of questions the scoring was difficult. It was, however, retained as a test in order that the results especially on the incidental memory for numbers could be used in making out the individual psychograms. In scoring the numbers, credit was given both for accuracy of number and within limits for approximating the correct number. For example, the answer to the third question is 298. If the correct answer was given, a total score of 6 was received, 3 points for the first number, 2 points for the second and 1 for the third. If 200 or 300 was given, a score of 3 was assigned, the argument being that in such a case the emphasis lay rather on the idea of about how many times a year on the average a person travelled on the subway than on rote memory for numbers. Of course any system of marking such results would be purely arbitrary and results obtained in such a manner would be useless were they designed to be used as absolute measures of memory; but here again, we simply want a system of grading which will distribute the group of subjects and show each one's position in relation to the other members of the group regardless of absolute score.

Because of the few numbers on sheet No. 5, it was dropped after the first group and sheet No. 6 substituted for the group for which the psychograms were later to be made.

The questions for sheet No. 6 were as follows:

1. Approximately how many miles per day do the Subway and Elevated trains travel? Give exact numbers if you can.
2. How many times the distance between what two cities?
3. Approximately how many horse-power-hours of electric energy is used?
4. How many trains would this run from Chicago to New York?
5. What was the title of the article?
6. What was the motto in the upper right hand corner of the sheet?
7. What was the date, month and the year of the article?
8. What was the picture in the center of the top of the sheet?
9. What was the number of the article?

The numbers were scored separately. The total possible score on this sheet for the numbers was 157 as against 49 points for the numbers on sheet No. 5. It therefore gave a finer distribution of subjects.

In this experiment, while diverting the attention to the worth of the advertisement, the subjects were at the same time warned to be careful to examine the "whole sheet," insuring so far as the examiner was able, the perception of the items which were to be called for later, and at the same time no hint as to remembering separate items was given. The print was large and easily read by all of the subjects. The objection might be made that some of the subjects, who had lived in New York were familiar with the sheet and their chances for remembering the pictures were better than those of the unfamiliar subjects. This is quite true although only a few of the subjects actually came from New York. But even with this objection granted, the results were used not so much for the sake of the picture and general heading as for the ability to remember numbers, and in the case of No. 6, these numbers were so long and the advantage would have been so slight for the New York City girls, that it was considered to have been negligible. Upon asking several of the girls who lived in New York City whether or not they remembered the numbers from having seen them on the subway, they answered emphatically in the negative.

In addition to the above experiments in incidental memory

a series of experiments from Poffenberger's Manual were selected and tried out on a small group which had previously taken some of the tests for incidental memory. The object here was to attempt to see what correlation, if any, there existed between incidental memory and other functions which are tested out in formal courses in Experimental Psychology. The experiments chosen for this comparison were (the numbers refer to the numbers in Poffenberger's Manual):

VI. Memory Span. Digits, letters, nonsense syllables and words.

VII. Relation between quantity of material and learning time. Results expressed according to number of repetitions and also time for 4, 8, 12, and 16 nonsense syllables.

XI. Efficiency of Recall and Recognition. Retained members method; score—number retained.

XII. Forgetting. Per cent saved, nonsense material.

XV. Memory for names and faces. Scores trials and errors for first and second days.

XXVI. Reaction time to Light.

XXXV. Range of visual perception. Quantity. Digits, letters, unrelated words, phrases.

These experiments were carried out in the regular course in Experimental Psychology and the results given over by the instructor to the writer. They were all performed in strict accordance with the directions given in Poffenberger's Manual.

Subjects

A total of 667 subjects in all were examined. Of these, 77 form the basis for the work on differences within the individual in incidental memory according to various kinds of material. This group of 77 was a class in Child Psychology. By using various devises for throwing the class off their guard, it was possible to give them all four tests for incidental memory without their suspecting that they would be called on for incidental material. The Magazine test was given first. Then the Subway Sun—they were told this was a different problem. Later they were again thrown off the track with the Colors and Letters test, represented as a study in judgment. Finally their own instructor gave them the paragraph test since they now associated the writer with work in memory, and also

because the directions were printed and the personal equation eliminated. Each subject was requested to state at the end of the paper whether or not she suspected the test of being an experiment in incidental memory.

Two hundred and eighty-seven of the subjects were used for only one test. The number is a total of several classes in Introductory Psychology.

The remaining 16 made up the small group in the class in Experimental Psychology, the results of whose experiments were used in the comparison with their results in the incidental memory tests.

Three hundred and twenty of the subjects were all students of Smith College, girls of around the same ages, ranging from 19 to 22 years, all taking some course in psychology. They were carefully instructed as to the experimental attitude toward tests and their cooperation was always gladly given. They were warned against discussing the tests in order that other groups might be used with valid results. The groups then were as homogeneous as one could wish for experiments of this kind, and the results therefore of two or more groups each composed of around forty students, are comparable.

Besides these, 121 students in Psychology (first year) from the Milwaukee State Normal School were used as subjects for the Magazine Test, Series II.

The remaining 176 subjects were sixth grade boys and girls of the Milwaukee Public Schools.

CHAPTER III

Results

The results of these experiments will be considered in the order indicated on page 3. The first problem then, is the study of the range of variation in several groups of subjects, in order to compare the variation or distribution of the groups in incidental memory material with direct memory material. Do individuals in a group differ from each other more widely in their ability to recall incidental material or material which has been intentionally learned? Or is the distribution of the group about the same regardless of whether the material has been attended to for the purpose of later recalling or simply perceived without any such intent?

In order to measure the variability of a group Pearson's formula for variability has been used. (Variability equals $\frac{\text{A.D.}}{\text{Average}}$).

In the following tables, the analysis is made, first according to the tests or material used, and secondly according to the groups tested.

From the table on page 38 the following conclusions can be drawn:

1. Although groups differ in variability for the three sections of the experiment, the results clearly indicate that there is a decided difference in variability in each group according to the kind of memory used.
2. Individuals vary least in recalling the order of memorized material.
3. Individuals differ most widely in recalling incidental material.

Conclusions

Since the scores are so high in the recognition part of the test, and the average so near the maximum score, no definite conclusions can be drawn. This is especially true when the score, "number right" is considered. But since there were

TABLE I

RANGE OF VARIABILITY

Magazine Test. Series I

Part. A. Direct Memory of Names of Magazines. Score: Percent correct of total

Group	Subjects	Average	A. D.	Variability
1	77	88.5	8.7	.098
2	26	87.0	10.8	.125
3	35	89.0	6.9	.077
4	30	83.1	13.9	.166
5	35	91.3	6.2	.067
Average		87.8	9.3	.106

Part B. Direct Memory of Order. Score: r (Spearman) true with given order

1	77	97.0	3.6	.037
2	26	94.0	6.8	.072
3	35	96.0	5.5	.057
4	30	90.2	7.4	.082
5	35	97.6	3.2	.033
Average		95.96	5.31	.055

Part C. Incidental Memory of Pictures. Score: Percent of max. possible

1	77	37.8	14.6	.386
2	26	50.2	13.8	.275
3	35	61.2	13.1	.213
4	30	63.7	12.2	.191
5	35	55.3	10.4	.189
Average		53.62	12.8	.220

Magazine Test. Series I. Part II. Recognition

A. Recognition of Names. Score: Number Right; Maximum—12

Group	Subjects	Average	A. D.	Variability
1	35	23.25	.83	.035
Score: Right-Wrong		22.40	1.66	.075
2	30	22.80	1.28	.056
Score: Right-Wrong		21.63	2.56	.118
Average		23.0	1.05	.046
		22.0	2.11	.096

B. Recognition of Pictures. Score: Number Right; Maximum—12

1	35	20.4	1.95	.096
Score: Right-Wrong		16.75	3.86	.230
2	30	20.7	1.96	.094
Score: Right-Wrong		17.40	3.93	.226
Average		20.5	1.955	.095
		17.07	3.89	.227

only two possible answers "yes" or "no," it would seem that the score "right minus wrong" should be considered, since the chances for a correct guess were equal. When the scores figured on a basis of right minus wrong are considered, the variability is practically doubled and compares favorably with the variability of the incidental memory part (C) of Part I of this experiment.

It would seem then that recognition is about as variable as incidental memory, and considerably more variable than direct memory for the same material.

TABLE I (Continued)

Magazine Test. Series II

Scores: A. Names. Number of Names remembered. Max. score 15.
B. Names in Order. Correlation of true with given order. Max. 1.00.
C. Pictures with Names. Number given correctly. Max. 15.

		First Presentation			*Second Presentation*		
		Average	A. D.	Variability	Average	A. D.	Variability
Group (28)	1	(Names Direct, Pictures Incidental)			(Names Incidental, Pictures Direct)		
	A	11.82	2.0	.168	*10.64	1.51	.141
	B	86.90	11.6	.133	*74.18	22.30	.300
	*C	3.60	2.12	.588	11.64	1.18	.101
Group (45)	2	(Names Incidental, Pictures Direct)			(Names Direct, Pictures Incidental)		
	*A	8.74	1.76	.201	12.62	1.18	.095
	*B	78.27	21.53	.275	93.18	7.40	.079
	C	8.00	2.46	.308	*10.24	3.00	.293
Group (48)	3	(Names and Pictures, both Direct)					
	A	9.58	1.84	.192			
	B	91.36	7.76	.085			
	C	8.52	1.75	.205			

*Incidental Memory

Note: The comparisons here of the variabilities of the different parts of the test are somewhat vitiated by the fact that the average score of the direct memory part was so high and hence the variability was necessarily low. In order to correct this matter Series II was given. Here the list was made longer and the procedure somewhat changed as noted in the preceding chapter.

This series gives a very much better distribution than Series I. The averages are lower and the variabilities somewhat larger on the whole.

A few facts are brought out by the above table:

1. Comparison of Results of First and Second Presentations

In each group the second presentation reverses the procedure of the first, so that the attention is shifted from the material intentionally remembered, to the incidental material. With this shift comes a certain compensation. When the attention shifts to the pictures even though the same magazines are shown in reverse order, the average drops for the number of names as does also the average correlation of the true and given order. On the other hand, the average for the pictures, now that direct attention is paid to them, increases about three-fold.

It is interesting to note that this kind of compensation does not take place in the second group where the pictures were the

original material for direct recall. Here the average increases in the second presentation even though the attention be shifted to the names and their order. This fact may be explained in either one of two ways: either pictures are better retained than names or else the subjects divided their attention during the second presentation, because of an interest in seeing whether or not they had correctly described the pictures, noting their errors. On the other hand in Group 1, the names probably did not elicit the same interest as the pictures so that on the second presentation the interest in the names was not carried over and the attention was directed especially toward the pictures. The latter explanation seems the more plausible.

2. Comparison of Variabilities

Here, as in Series I, we find the greatest variability for incidental memory of pictures (Group 1, C). In direct recall also we find the variability for pictures (Groups 2 and 3, C) considerably larger than for the direct recall of either the number of names or their order. (Groups 1 and 3, A. and B).

Except in the case of Group 1, B, (Order of Names, Incidental Memory), the variabilities decrease for the second presentation. The exception in Group 1, B, i.e., the increase in variability, was probably due to confusion resulting from reversed order.

3. Control Group

The results of this group serve as check on the others. The averages in each case are higher for Direct Memory than for incidental memory (for a single presentation). In this group the attention was directed to both the pictures and names in order. We might suppose that the averages for Direct Memory would be somewhat lower in this case than when the attention was directed to only one element—either the names in order, or the pictures. We find, however, the following results:

A. For the number of names, the average for the Control Group is lower than for Group 1, where the names in order were the material for direct memory, the averages being, for Groups 1 and 3 respectively, 11.82 and 9.58.

B. For the order of names the average correlation was higher in the Control Group than in Group 1, being 91.36 and 86.9, respectively.

C. For pictures there was very little difference. The average for Group 2 (direct memory of pictures) was 8.0, while in Group 3, (Control Group), it was 8.52.

We might summarize these last three statements by saying that attention to two problems rather than one resulted in decreased efficiency in recalling the number of names, increased efficiency in recalling the order of the names, and made practically no difference in the number of pictures correctly remembered in connection with the names of the magazines.

TABLE I (Continued)

PARAGRAPH TEST

Part I. Recall

A. Direct Memory Material. Score: Number Correct. Maximum—20

Group	Subjects	Average	A. D.	Variability
1	77	17.1	1.68	.098
2	34	15.6	1.97	.126
3	40	17.0	2.02	.119
Total	151 Average	16.57	1.89	.114

B. Material Related to Direct Memory. Score: Number Correct. Maximum—20

1	77	11.80	4.0	.339
2	34	8.69	3.80	.437
3	40	11.05	3.25	.294
Total	151 Average	10.51	3.68	.350

C. Incidental Material. Score: Number Correct. Maximum—20

1	77	6.85	3.0	.438
2	34	5.57	2.6	.467
3	40	6.23	2.7	.433
Total	151 Average	6.22	2.76	.444

Part II. Recognition

A. Direct Memory Material. Score: % of total. Maximum—100

Group	Subjects	Average	A. D.	Variability
1	77	92.7	6.83	.073
2	34	86.8	8.30	.095
3	40	92.7	7.05	.076
Total	151 Average	90.75	7.39	.081

B. Material Related to Direct Memory. Score: Same as above

1	77	81.7	12.35	.151
2	34	70.1	15.60	.222
3	40	80.9	11.07	.137
Total	151 Average	74.2	12.83	.173

C. Incidental Material. Score: Same as above.

1	77	68.8	19.60	.285
2	34	63.5	17.26	.271
3	40	61.0	17.25	.282
Total	151 Average	64.44	18.03	.279

Part III. Direct Memory for Entire Paragraph

Number of Subjects—27. Score: Same as Part I

	Average	A. D.	Variability
A	14.4	2.1	.146
B	14.4	2.1	.146
C	11.3	4.13	.365

The results of the Paragraph test reveal the following:

1. There is a great difference in variability between the intentionally remembered and the incidental material; the subjects vary less than one-third as much in direct memory (A) as in either of the other two parts (B or C).

2. The memory for the intermediate material (B) varies more than for the direct material (A) and not so much as for the incidental material (C).

3. As the averages decrease, the variabilities rise, so that we find the averages for the incidental material the lowest and the variability the highest. Obviously the direct memory part of the test did not distribute the group so well as the incidental memory part. The test was devised primarily for incidental memory and the distribution here shows it to be an adequate test. The high average and low variability in the case of direct memory for the same amount of material brings out the contrasts between the results obtained when the questions are concerned with material intentionally remembered and at the same material observed but not attended to for the sake of later recall.

4. In recognition, Part II, while the variabilities are considerably lower than for Part I, the same relationships hold true, namely that the variability for incidental memory is consistently higher than for either of the other two parts; and again the results for Part B stand as an intermediary between the direct memory results and those for incidental memory.

5. In comparing the variabilities of Parts I and III (entire paragraph given as test in direct recall), we see that the higher variability of Part C is due partly to the nature of material as well as to the fact that the attention given to it was not direct. The average for the direct memory of Part C is much higher than for incidental memory of the same material (11.3 and 6.22 respectively), the variability drops somewhat (.444 for incidental memory and .365 for direct memory). There is still sufficient difference between the averages and variabilities for incidental and direct memories of Part C to indicate that even for this kind of material incidental memory is more variable than direct memory.

In considering Parts A and B of III, we find their averages and A.D.'s exactly the same. At the same time the variability is higher for A and lower for B in Part III than in Part I. This would indicate that when the attention was directed to

the entire paragraph (Part III) the differences in averages and variabilities of parts A and B, which were made up of closely allied material, vanish. The higher variability then of B over A in Part I is due to the fact that A was direct recall, while memory for B was for the most part incidental.

TABLE I (Continued)

SUBWAY SUN

Contents. Score: Number Correct. Maximum—16				
Group	Subjects	Average	A. D.	Variability
1	26	7.80	2.38	.305
2	41	7.24	2.85	.386
3	33	7.84	1.90	.242
4	35	6.60	2.31	.350
Total	135	7.37	2.36	.320
Numbers. Score: Number correct. Maximum—157				
1	26	33.50	18.9	.564
2	41	43.04	16.8	.388
3	33	41.77	18.1	.431
4	35	37.57	17.9	.476
Total	135	38.97	17.9	.458

Both the Contents and the Numbers were incidental material. The results show that individuals vary more widely in their incidental memory for numbers than for ideational material related to the numbers.

TABLE I (Continued)

COLORS AND LETTERS TEST

A. Incidental Memory. Score: Number Correct. Maximum—10				
Colors				
Group	Subjects	Average	A. D.	Variability
1	77	5.35	2.36	.441
2	25	6.24	2.00	.320
3	27	4.03	2.55	.633
4	36	5.25	1.90	.362
Total	165	5.22	2.20	.421
Letters				
1	77	2.05	1.50	.731
2	25	2.08	1.41	.673
3	27	2.63	1.96	.745
4	36	2.63	1.40	.532
Total	165	2.35	1.56	.664
B. Recognition				
Colors				
1	75	7.0	1.81	.259
2	25	6.7	1.57	.234
3	27	6.5	1.92	.295
Total	127	6.73	1.76	.261
Letters				
1	75	4.9	2.06	.420
2	25	4.2	1.60	.376
3	27	4.5	2.02	.447
Total	127	4.5	1.89	.420

C. Direct Memory. Score: Number Correct. Maximum—10
Number of Subjects—72

	Average	A. D.	Variability
Colors	8.7	1.7	.195
Letters	7.5	2.3	.306

In summing up the above tables we find:

1. The averages for incidental memory of letters are about one-half of those for colors and the variabilities considerably higher. This would indicate that for the same amount of material the incidental memory for colors is much better than for letters.

2. In comparing recognition with recall, we find considerably less variability and higher averages for the recognition of incidental memory material than for its recall. We should

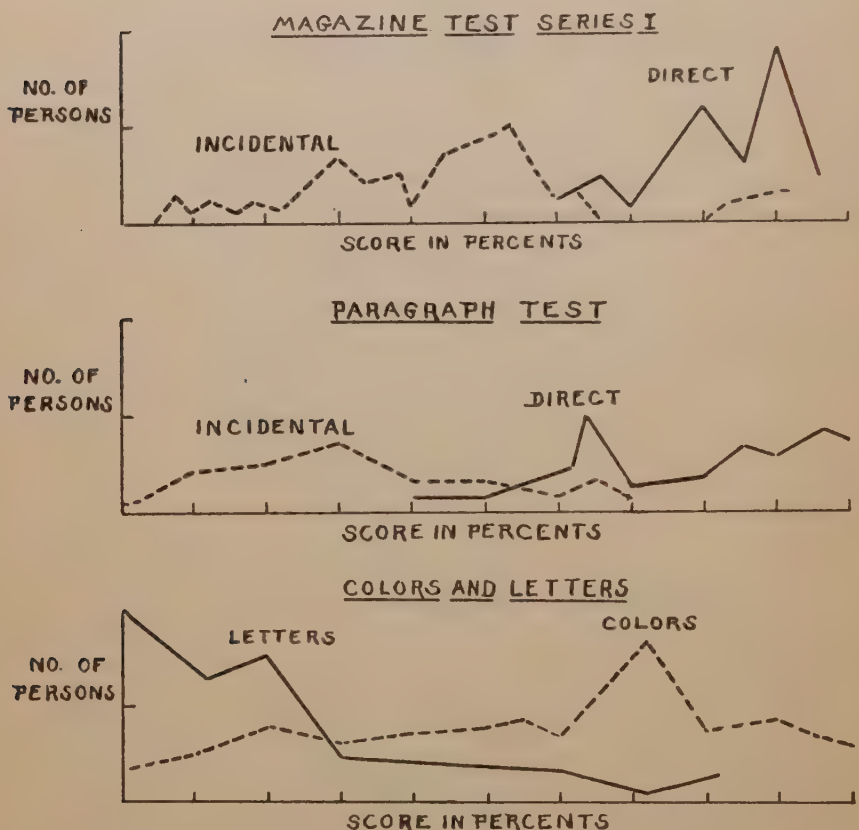

Chart II. Distribution of Different Parts of the Same Tests

expect this to be the case since recognition is easier than recall and in this experiment the chances for guessing right in recognition were one out of four. In recognition as well as recall, the averages for letters are lower than for the colors; the difference is not so great in recognition as it is in recall and the variability is considerably higher.

3. For direct recall for colors and letters, the averages are raised and the variabilities lowered as compared with incidental memory, again indicating as in the previous experiments greater variability for incidental than for direct memory of the same material.

TABLE I (Continued)

COLORS AND FORMS

Score: Number Correct. Maximum—12

	Part I (First Presentation)			*Part II* (Second Presentation)		
	Average	A. D.	Variability	Average	A. D.	Variability
Group 1 (44)	Forms Direct, Col. Inc'l., Forms Inc'l., Colors Direct					
A (Forms)	3.34	1.60	.489	*5.40	1.75	.324
*B (Colors)	1.52	.99	.651	4.11	2.17	.530
Group 2 (45)	Forms Inc'l., Colors Direct, Forms Direct, Colors Inc'l.					
*A (Forms)	3.30	1.80	.545	6.15	2.25	.366
B (Colors)	4.30	2.23	.518	*5.64	2.25	.452
Group 3 (38)	Control Group, Forms Direct, Colors Direct					
A (Forms)	3.4	1.82	.535			
B (Colors)	2.6	1.62	.623			
Colors with Forms Incidental, Forms with Colors Incidental						
*A (Forms with Colors)				2.8	1.43	.510
*B (Colors with Forms)				3.1	1.54	.201

*Incidental Memory

1. Comparison of Results of Colors and Forms

In comparing incidental memory (first presentation) for forms with that for colors, we find the averages for the forms higher. Evidently it was easier for the subjects to remember the positions of the forms on the chart than those of the colors.

In direct memory, when the attention was directed either to the colors or the forms alone (groups 1 and 2, first presentation), the average for the colors (4.30) is somewhat higher than for the forms (3.34).

In group 3 where the attention was directed to the colors and forms at the same time, the average for the colors fell below the average for the forms.

It would seem then, that the memory for the position of forms is better on the whole, than for the position of colors, whether that memory be direct or incidental.

2. Comparison of Results for First and Second Presentation

Although in the second presentation, the attention, in each case, was directed to the positions of either the colors or the forms in reverse order from the procedure of the first presentation, the incidental material of the second presentation is not, of course, strictly incidental, since the attention had been directed to it for the first presentation. In every case therefore, it is not surprising to find that the averages both for the incidental and for the direct memory increased.

3. Comparison of Direct Memory in Groups 1 and 2 with Control Group

In the case of colors, the average for Group 2 (B) was higher (4.30) than in Group 3 (B) (1.62), while in the case of forms the averages remained about the same (3.34 and 3.40). Directing the attention to two sets of material, then, instead of only one to be remembered seemed to have the following effect: it reduced the average for the position of colors, cutting it almost one-half, while the average for the position of forms was practically uninfluenced.

The variabilities were greater for both colors and forms in the control group than in group 1, A or 2, B. This would indicate that when the subjects had two problems to keep in mind, the memory was more variable, whether for forms or colors, than when the attention was directed to only one problem, as in groups 1 and 2.

4. Comparison of Incidental and Direct Memory

There was very little difference in the results for the recalling of positions of forms, whether by direct or incidental memory. The averages are about the same (3.34 and 3.30). The variability, however, was higher for incidental memory. (.498 and .545.) More striking differences are found in the results for direct and incidental memory of positions of the colors. Here the average jumped from 1.52 (Group 1, B) for incidental memory to 4.30 (Group 2, B) for direct memory, and the variability decreased from .651 to .518. It would seem then, that the memory for the positions of forms does not depend upon intentional learning so much as does the memory for the position of colors.

5. Comparison of Incidental Memory of Colors with Forms with Incidental Memory of Forms with Colors.

This was a separate problem which suggested itself. In the preceding studies the results for the memory of the position on the chart of the forms and colors were studied. This little additional experiment was designed to see whether or not the subjects had linked up the colors, each with its own form. It was tried out for incidental memory only, on Group 3.

The results show that when the colors were shown and the subjects asked to draw the appropriate forms, the average was low, 2.8, and the variability high, .510; on the other hand when the forms were shown and the subjects asked to name the colors, the average was 3.1 and the variability only .201. It was evidently easier for the subjects to associate the proper color with the form, than to recall the form, having been shown the color.

TABLE II

Re-Arrangement of Material of Table I
Showing Differences Within the Same Group According to Material

Group 1. 77 Subjects

Test		Average Recall	Recog.	A. D. Recall	Recog.	Variability Recall	Recog.
*Sub. Sun	C	6.21		2.8		.452	
*Sub. Sun	N	26.2		12.0		.459	
Magazine	A	88.5		8.7		.098	
Magazine	B	97.0		3.6		.037	
*Magazine	C	37.8		14.6		.386	
Paragraph	A	17.1		1.6		.098	
Paragraph	B	11.8		4.0		.339	
*Paragraph	C	6.8		3.0		.438	
*Colors		5.35	7.0	2.3	1.81	.441	.259
*Letters		2.05	4.9	1.5	2.06	.731	.420
Colors (D)		8.7		1.6		.195	
Letters (D)		7.5		2.3		.306	

Group 2. 26 Subjects

*Sub. Sun	C	7.8		2.4		.305	
*Sub. Sun	N	33.5		18.9		.564	
Magazine	A	87.0		10.8		.125	
Magazine	B	94.0		6.8		.072	
*Magazine	C	50.2		13.8		.275	
*Colors		6.24	6.7	2.0	1.6	.320	.234
*Letters		2.98	4.2	1.4	1.6	.673	.370

TABLE II.—(Continued)

		Group 10. 35 Subjects		
*Sub. Sun	C	6.6	2.3	.350
*Sub. Sun	N	37.6	17.9	.476
Magazine	A	91.3	6.2	.067
Magazine	B	97.6	3.2	.033
*Magazine	C	55.3	10.4	.189
*Colors		5.25	1.9	.532
*Letters		2.63	1.4	.362

(D) Indicates direct memory test on similar material

* Indicates incidental memory material

Note: These were the only groups which were given more than one test. The Subway Sun results for Group 1 cannot be compared with those for the other groups, since this was the only group given Sheet No. 5.

Discussion of Results:

Upon examining the averages and A.D.'s of Table II we see that the variability of a group depends upon the kind of material used. It is also of course greatly influenced by the fact that some of the tests, notably Magazine A and B and Paragraph A, were so easy that a large number of perfect scores were made. This brought up the averages and decreased the A.D.'s.

In the Subway Sun, Contents, test, the range of scores was so limited that the variability for this test is not significant.

In the Colors and Letters Test, the bunching of the scores is at the lower end, and hence the averages are low.

It was with a view toward correcting the undistributed perfect scores of the Magazine test and the large number of low scores for the Colors and Letter Test, that the supplementary experiments were devised.

In comparing the variabilities of the different tests a very formidable difficulty presents itself. The differences in range of scores, and more especially the different units used in scoring, make such comparisons valueless. The comparison of variabilities is feasible only when the comparison is made between two parts of the *same* test when the same material has been used.

General Conclusions:

1. Group variability in incidental memory depends upon the kind of material used.

2. Because of the fact that the direct memory material in many of the tests was apparently easier for the subjects than the incidental material, so that for direct memory there was a bunching at the upper end, the two variabilities cannot well

be compared. In the second series of each of the two tests supplemented, however, the scores were more evenly distributed, and here we find a much higher index of variability for incidental memory material than for direct memory of the same material. The averages are lower and the A.D.'s are larger when the material was presented as incidental.

3. The averages for the incidental memory of colors are higher than those of letters.

4. Disconnected material such as numbers, letters and typographical errors had averages (in proportion to the total amount presented) considerably lower than meaningful material. The A.D.'s ranged from being proportionately very small to very large, showing that though the averages were low, the distribution need not necessarily be either narrow or wide, but depended upon the kind of material used.

CHAPTER IV

(Results, continued)

Individual Differences in Incidental Memory

In the preceding chapter the subject of variability has been considered for the groups as wholes, the comparison being made between the variabilities of the groups for direct and incidental memory for the four experiments.

In the following Chapter a study will be made of the variability of individual subjects, in regard to both Incidental and direct memory for different kinds of material. The question to be answered is: Are individuals who are above the average in incidental memory for one kind of material necessarily above the average in other kinds of material also? Is there a high or low correlation, positive or negative, between the incidental memory for colors, for example, and letters, and for all other kinds of material tested?

For this study a group of seventy-seven subjects was used. All of the experiments were tried out on them, care being taken each time that no suspicion was aroused of the fact that the experiment was one for incidental memory. This was possible by arranging the experiments as follows: The Subway Sun experiment was given first, then the Colors and Letters. There was no need to disarm the subjects very much for the second experiment, it was sufficient to tell them that last time their memory had been tested, this time an experiment in judgment would be given them. The third experiment was the Magazine Test. Here it was announced that this time Memory would be tested, and attention then was directed to the names of the Magazines and the order in which they were presented. For the final Experiments, the Paragraph test, the writer was assisted by the instructor of the class who explained that she would like to conduct an experiment on Memory. Incidental Memory having been formerly associated with the writer and experiments on Association and Recall associated with the instructor who was working on that subject at the time, no suspicion was aroused concerning the remembering of the incidental material.

TABLE III

SCORES OF 77 SUBJECTS ACCORDING TO $\frac{d}{A. D.}$'s FROM AVERAGE IN ALL PARTS OF THE FOUR EXPERIMENTS

Subject	*Subway Sun*		*Magazine*			*Paragraph*			*Colors and Letters*			
									Incidental		Direct	
	C	N	A	B	C	A	B	C	C	L	C	L
1	−1.5	−2.1	+1.4	0	−.75	+1.2	+ .25	−1.0	− .4	+1.3	—	—
2	−1.1	−1.1	+ .4	0	+ .4	− .6	−1.7	−1.0	− .8	+2.0	−2.2	−1.1
3	+ .2	+ .2	− .5	+ .8	+ .8	− .6	+ .7	0	−1.2	−1.3	−3.4	−2.8
4	+ .2	+ .2	+ .4	+ .8	−1.7	+ .6	− .25	+ .3	0	+1.3	− .3	+ .2
5	+1.4	+1.2	+ .4	− .8	− .6	+ .6	−1.5	−1.0	0	0	+ .3	− .6
6	− .07	+ .2	+ .5	+ .8	+1.4	−1.7	+ .7	−1.0	+2.0	+2.0	+ .9	+1.1
7	+ .6	+1.6	+ .4	+ .5	+1.2	+1.7	+1.0	− .66	+ .8	−1.3	+ .9	+1.1
8	+1.0	−1.1	+ .8	− .8	+1.2	+ .6	− .7	+2.0	−1.6	0	−1.5	−2.8
9	− .4	− .2	−1.5	+ .3	+ .7	0	+1.2	− .3	+ .8	+ .66	+ .9	+1.1
10	+ .6	+1.7	+1.4	+ .5	+ .9	+ .6	+1.2	+1.3	+1.2	+1.3	+ .9	+1.1
11	+1.0	−2.1	− .5	+ .5	+ .9	+1.7	+1.0	+ .6	+ .8	−1.3	+ .9	+ .2
12	+ .6	+1.1	+1.4	+ .8	+ .3	− .6	−2.2	− .3	0	0	+ .9	+ .2
13	+ .6	+ .2	−2.5	−1.1	− .1	0	+1.0	+1.6	+ .8	− .66	+ .9	−1.1
14	+2.4	− .7	+ .4	0	+ .8	−1.2	− .25	+1.0	−1.6	−1.3	− .9	−1.9
15	−2.1	+1.7	−1.5	+ .8	+2.8	−1.7	−2.25	− .3	−1.2	−1.3	−1.5	−1.5
16	+ .4	+ .3	− .1	+ .3	−1.3	−1.2	− .25	+1.3	0	− .66	− .9	−1.5
17	+2.1	+1.7	+ .4	+ .5	− .1	+ .6	+1.25	+ .66	+1.6	+2.66	+ .9	+1.1
18	−1.5	− .5	+1.4	+ .8	−2.5	+ .6	+1.25	−1.0	−1.2	−1.3	− .3	− .2
19	−1.5	−1.6	− .5	− .5	−1.7	−1.7	− .5	− .3	−1.2	− .66	−.3	− .2
20	− .8	+ .7	+1.4	+ .5	+1.5	+ .6	+1.25	0	+2.0	+4.0	+ .9	+1.1
21	− .4	+2.2	+1.4	+ .8	+1.9	+1.2	+1.25	− .66	0	−1.3	+ .3	+1.1
22	− .4	+1.8	+ .8	0	+1.5	+1.2	+ .25	− .66	+ .8	+ .66	+ .9	+ .6
23	− .8	− .2	+1.4	+ .55	− .3	+1.7	+1.5	− .66	+ .8	+ .66	− .3	+ .2
24	+2.4	+1.7	− .5	− .3	+1.9	+ .6	+ .25	+ .3	+1.6	+2.0	+ .9	+1.1
25	+ .2	−2.5	+ .8	+ .8	−1.7	0	−1.0	− .66	−2.0	−1.3	+ .3	−1.5
26	−1.5	− .6	− .1	−1.4	− .4	− .6	− .5	−1.66	−1.2	−1.3	+ .9	+ .2
27	+ .6	+ .7	+1.4	+ .3	+ .3	0	+1.25	+2.66	+ .8	0	—	—
28	−1.1	− .5	+ .4	+ .8	+1.5	+ .6	+ .5	− .66	+ .4	+2.0	+ .9	+1.1
29	+1.4	+1.7	+1.4	+ .8	+1.0	+ .6	+1.5	−1.3	+1.2	+ .6	+ .9	+1.1
30	+1.7	− .2	+1.4	+ .8	+ .4	−1.2	+ .5	−1.3	—	—	—	—
31	−1.5	−2.1	−3.0	−7.2	−1.8	−1.7	−2.25	−1.66	—	—	—	—
32	−1.1	+ .2	− .5	+ .3	+ .9	− .6	−1.25	+3.0	−1.2	− .6	+ .3	+ .6
33	−1.8	− .2	− .5	+ .8	+ .9	+ .6	− .37	+ .66	+1.6	+3.3	+ .9	+1.1
34	−2.2	+2.2	+1.4	+ .55	− .6	−2.3	+ .5	− .3	+ .8	0	−1.5	− .2
35	−1.1	−2.3	+1.4	+ .55	+ .9	− .6	−1.25	−1.3	−1.6	0	− .9	− .2
36	− .4	+ .2	+ .4	+ .55	− .1	+ .6	+ .25	+1.66	+1.6	+2.66	+ .9	+1.1
37	+ .6	+ .2	+1.4	+ .8	+1.2	− .6	−1.0	−2.0	− .8	0	− .3	+ .2
38	+1.0	+1.3	+ .4	+ .8	− .8	− .6	− .25	−1.66	+ .4	−1.3	+ .9	+1.1
39	−1.4	+ .5	+1.4	+ .8	+1.4	− .8	+ .37	− .66	+1.2	− .66	+ .9	+1.1
40	− .4	− .2	+ .4	−1.4	+ .9	− .6	0	+1.3	+2.0	+2.66	+ .9	− .2
41	+1.0	+1.7	−1.5	+ .8	−1.3	+ .6	−2.25	−1.66	0	−1.3	+ .9	+1.1
42	+1.0	+1.3	+ .4	+ .55	− .75	+ .6	−1.5	− .3	− .8	− .6	+ .9	− .2
43	− .4	−1.1	+1.4	0	−1.8	+1.2	− .9	−1.0	− .4	−1.3	+ .9	+1.1
44	−1.1	−1.7	−2.5	+ .8	− .4	+1.7	− .25	+ .3	− .4	−1.3	− .3	− .6
45	−1.1	−1.1	−2.5	−1.1	− .75	+ .6	−2.0	0	−1.2	−1.3	—	—
46	−1.1	+ .7	+1.4	− .8	+ .9	+1.7	− .5	0	+ .8	0	—	—
47	+1.4	+ .2	+1.4	−1.4	− .4	+1.7	+1.1	+ .66	+ .4	+1.3	+ .9	+1.1
48	−1.1	+2.0	+1.4	+ .8	− .6	+1.2	+1.8	+3.0	+ .8	−1.3	− .3	+ .6
49	− .8	−2.1	−2.5	+ .8	+ .4	0	−1.1	−2.0	+ .8	−1.3	+ .9	+ .2
50	− .8	+ .3	− .1	+ .8	−2.0	0	− .5	− .3	0	0	+ .9	+1.1
51	−1.1	+ .2	− .5	+ .5	− .6	+ .6	− .9	− .3	− .4	+2.0	+ .9	+ .2
52	+1.0	+ .7	+1.4	+ .8	+ .8	0	− .25	+ .66	+1.6	+1.3	+ .9	+1.1
53	− .07	− .2	− .5	+ .3	− .3	+ .6	+1.37	− 0	+1.2	− .6	+ .9	+ .6
54	− .8	+1.7	+1.4	+ .8	− .1	−1.2	+1.7	−1.3	+1.6	−1.3	—	—
55	+1.7	− .2	+ .4	+ .3	+3.6	+1.2	+1.0	−1.3	+ .8	− .6	+ .9	+ .6
56	− .4	−2.1	+ .4	+ .8	+1.3	+ .8	+ .37	− 0	+ .8	−1.3	+ .9	+1.1
57	+ .6	+1.2	− .5	+ .5	−1.8	− .6	−1.9	− .3	− .8	− .6	+ .9	−1.5
58	−1.4	− .2	+1.4	−1.4	− .7	−1.7	− .5	−1.0	− .4	−1.3	+ .9	− .2
59	−1.1	+1.7	+1.4	+ .8	+ .4	—	—	—	+ .8	+ .6	—	—
60	−1.1	−2.1	+1.4	+ .8	+ .8	+ .6	+ .25	+2.0	+1.6	− .6	+ .9	− .2
61	−1.1	−2.5	−1.3	+ .8	− .6	−1.2	−1.75	+1.66	+ .8	0	− .3	− .2
62	− .4	− .2	+ .4	− .3	+ .2	+ .6	+ .6	0	—	—	−2.2	−1.5
63	− .8	− .5	+1.4	+ .8	+ .8	−1.2	−2.0	− .66	+1.6	− .6	+ .9	+1.1
64	−1.5	− .2	−2.5	+ .8	−1.8	+2.7	0	−2.0	+ .8	0	+ .3	+ .6
65	+ .6	−1.6	+ .4	−6.1	−1.1	+ .8	+1.0	0	−1.2	−1.3	−4.7	−1.9
66	+1.7	−1.1	+1.4	+ .5	− .3	−2.3	+ .25	−1.66	+1.2	0	+ .9	+1.1
67	+1.7	+1.2	+ .4	0	−1.8	+1.2	+ .5	+2.0	+1.2	+2.0	+ .9	+1.1
68	+ .2	+ .5	−5.5	+ .8	+1.2	−3.5	+1.75	+ .66	−2.0	−1.6	+ .9	+1.1
69	+ .6	+1.3	−1.5	−2.0	+1.7	+1.7	+1.5	+ .3	+ .4	0	+ .9	+1.1
70	− .8	+ .7	− .4	+ .8	+ .4	+1.7	−1.75	+3.0	0	0	+ .9	+1.1
71	−1.5	−2.1	−1.5	+ .3	− .4	—	—	—	− .8	− .6	− .3	−1.1
72	−1.5	− .5	−1.5	−13.0	−1.4	− .8	−1.75	−1.66	− .4	−1.3	−2.8	−2.8
73	+1.4	+1.7	+ .4	+ .8	+ .4	+ .6	+1.0	0	—	—	− .9	− .6
74	− .4	− .2	+ .4	+ .8	−2.3	−1.7	−1.5	−1.3	−1.6	0	−1.5	−1.5
75	+1.0	− .5	−1.5	− .55	+ .2	+ .6	+1.25	+1.3	+ .4	0	−2.2	−1.5
76	− .07	− .6	− .5	+ .55	− .4	+1.7	−1.25	+2.0	+ .4	+ .6	+ .9	+1.1
77	+1.7	+ .2	− .5	+ .8	− .6	+ .3	− .75	+1.0	− .4	−1.3	+ .9	+ .6

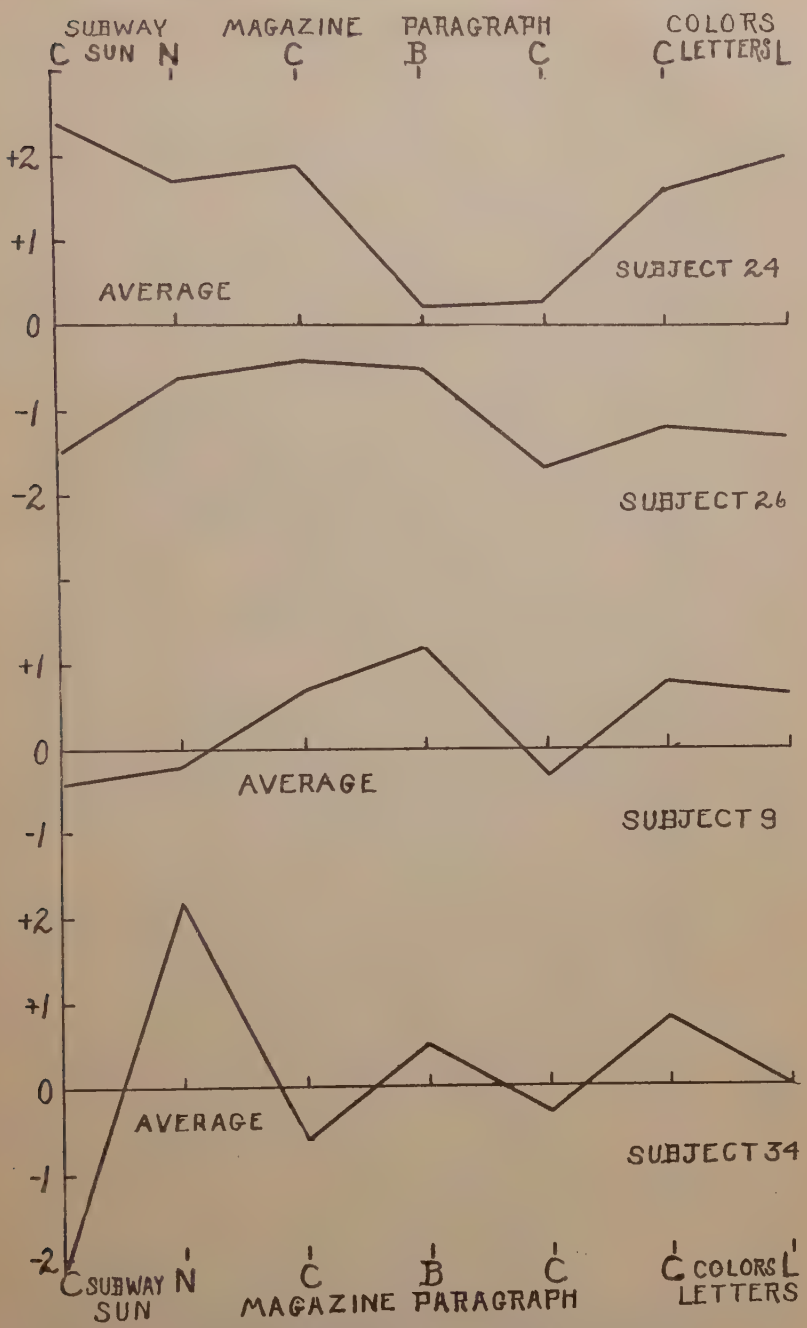

Chart III. Psychograms of Subjects according to Incidental Memory Tests

From an examination of Table III, the answer to the question stated at the beginning of this chapter is apparent. Individuals differ widely in their accomplishments in incidental memory. An individual who may have an excellent incidental memory for colors when compared with the rest of her group may have a very poor one for letters, when the same comparison is made. The pattern of a subject's accomplishment is not fixed but may assume any one of a number of shapes. Chart II shows in detail four patterns of accomplishment in the incidental memory experiments. Subject 24 was consistently above the average in each one of the tests; Subject 26 consistently below the average, Subject 9 hovered around the average, sometimes falling a little below, sometimes going a little above, while Subject 34 has a rather more eccentric psychogram, jumping from far above the average in one experiment to far below it in the second part of the same experiment.

The following table of Correlations, Table IV, will show for the entire group, what Table III and Chart III have shown for the Individuals considered separately.

Although the Average Correlation is positive, it is very low, and certainly would not point toward any unit factor which could be considered the common element of Incidental Memory. The highest correlations are found between those tests whose material was the simplest..the correlation between colors and letters being + .37, and Colors and number + .305, and of forms with colors or colors with forms + .545.

The Magazine test correlated next highest with the other tests, and the contents part of the Subway Sun Experiment was the lowest. The paucity of material in the Contents experiment would of course greatly influence the results, indeed because of this fact, the experiment was considered to be unreliable and its results have been disregarded as having any weight.

It is not surprising that the correlations should be low for we find that in direct memory material, individuals vary to a large extent in their performances, where the conditions are directly under the subjects control; we would expect to find even greater variability in the case of Incidental Memory.

In comparing the correlations of the direct memory parts with each other, and those of the Incidental Memory parts of

TABLE IV

Correlations Between Tests for Incidental Memory

	Subway Sun								Magazine C	
	Letters	P.E.	Colors	P.E.	Contents		Numbers			
	r		r		r	P.E.	r	P.E.	r	P.E.
Paragraph C	+.165	±.074	+.14	±.074	+.234	±.07	+.05	±.075	+.086	±.075
Letters			+.37	±.068	-.008	±.075	+.20	±.071	+.225	±.07
Colors					+.08	±.075	+.305	±.066	+.28	±.068
Contents							+.28	±.068	+.26	±.071
Numbers									+.28	±.068

Average Correlation for Incidental Memory = +.199
Median +.225

Additional Experiments:

Control group:

Forms with colors and colors with forms.

r = +.545 ±.11

Magazine Series II. Group 2.

Number of names with order of names. (A & B)

r = +.16 ±.12

TABLE V

Correlations Between the Direct Memory Parts of Various Experiments

	Paragraph A	P.E.	Letters	P.E.	Colors	P.E.
Magazine A	+.15	±.063	+.15	±.063	+.06	±.08
Paragraph A			+.24	±.076	+.19	±.078
Letters					+.77	±.032

Average Correlation .....+.26 Median +.17

Additional Experiments

Colors and Forms

Control Group. Position of colors with position of forms

r = +.51 ±.08

Magazine Test. Series II.

Group 1, Number of names with order (A & B)

r = +.22 ±.12

Group 3, Number of names with order (A & B)

r = −.10 ±.09

Number of names with pictures (A & C)

r = +.37 ±.083

the experiments, while the average is somewhat higher for the Direct Memory, the median is higher for the Incidental Memory. The comparison is not quite fair, since there were not so many direct memory tests given. The results, however, do indicate that Memory is not a unitary process whether it be direct or incidental and that for the same individual the results may vary according to the kind of material used in the test.

CONCLUSIONS:

An individual is not necessarily consistent in her ability to remember incidental material, she may vary greatly according to the material. In the above experiments several kinds of materials have been used. In some of the experiments, the subjects were simply asked to recall separate facts, in others, as in the Colors and Letters, and Colors and Forms experiments, the facts to be recalled were more in the nature of connections,—the form of a color or color of a form, etc. It would not therefore be a usual or typical case to find an individual with a "good Incidental Memory" (leaving the statement unqualified) for while the individual may remember certain kinds of material to which she has not attended for the purpose of remembering, but has experienced only incidentally to some main interest, it does not necessarily follow that she will be able to recall other kinds of material better than the average..she may, indeed, fall very short of the average in her incidental memory for things other than her specialty.

CHAPTER V

A Study of the Relation Between Incidental and Direct Memory

The question to be answered in this Chapter is: What is the relation between the ability to remember incidental material and the ability to recall learned material *in the same individual?* Does the person who memorizes well also have good incidental memory, on the whole, or is there an inverse relationship, or none at all?

In order to make this comparison, a consummate score was devised according to the suggestion of Professor Woodworth. The individual's relative standing in the group was assigned by giving her deviation, plus or minus, from the group average, divided by the A.D. of the group. The averages then, of the $\frac{d}{A.D.}$ obtained in this way, of each subject for all of the test for direct memory, was computed and this list correlated with the averages of the $\frac{d}{A.D.}$ for all the tests for Incidental Memory.

The following table shows the results computed in the above manner for sixty-six subjects.

The correlation between the summation scores for incidental memory and for direct memory is $+ .34$, P.E. $\pm .07$, which is somewhat higher than the correlations for incidental memory of various material or direct memory for different kinds of material. This would seem to point to the fact that there is a closer relation between incidental memory and direct memory than between incidental memory of one kind of material with that of another kind of material, or direct memory of two different kinds of material.* The probable errors for

*The question arises as to whether or not a high score in incidental memory militates against a high score in direct memory. It would seem that this could not be the case since the correlation here is positive. In this as in the number of items remembered, people undoubtedly differ widely. It is quite probable that in some individual cases, the high score in incidental memory was made at the expense of a score in direct memory which would have been higher had the attention not been wandering over the incidental material. Experiments could be devised which would bring this point to light. From the above figures there are no indications either one way or the other.

TABLE VI

$\frac{d}{\text{A. D.}}$ for all Incidental Memory Tests and for all Direct Memory Tests

Subject	Av. I. M.	Av. D. M.	Subject	Av. I. M.	Av. D. M.
1	− .56	− .70	34	− .13	+ .30
2	− .28	−1.30	35	− .16	+ .52
3	− .01	+ .34	36	+ .13	+ .68
4	+ .16	+ .06	37	+ .13	− .18
5	+1.08	+ .32	38	− .81	+ .18
6	+ .21	+ .92	39	− .01	+ .44
7	+ .25	− .74	40	−1.00	+ .92
8	+ .06	+ .70	41	− .76	− .18
9	+1.16	+ .90	42	+ .60	+ .74
10	− .01	+ .56	43	+ .46	+ .74
11	+ .28	+ .54	44	− .70	− .12
12	+ .41	− .76	45	− .46	+ .52
13	+ .01	− .72	46	− .03	+ .32
14	00	−1.08	47	+1.00	+1.00
15	+ .01	− .64	48	+ .32	—
16	+1.41	+ .70	49	+ .66	+ .68
17	−1.33	+ .46	50	− .30	+ .80
18	−1.15	− .66	51	− .30	− .24
19	+1.23	+ .90	52	− .80	− .20
20	+ .30	+ .96	53	+ .10	+ .70
21	+ .61	+ .70	54	− .30	+ .44
22	− .08	+ .70	55	− .02	+ .56
23	+1.65	+ .36	56	− .80	+ .18
24	−1.18	+ .68	57	− .75	+1.20
25	−1.10	+ .20	58	− .02	+ .32
26	+ .66	—	59	+1.05	+ .48
27	+ .28	+ .70	60	− .20	−1.20
28	+ .76	+ .96	61	+ .70	+ .40
29	+ .06	+ .02	62	+ .10	+ .98
30	+ .73	+ .58	63	−1.10	−4.18
31	− .01	− .42	64	− .90	− .70
32	− .90	− .40	65	+ .40	−1.02
33	+ .91	+ .70	66	+ .30	+ .72

*Correlation + .34 P. E. ± .07

the two sets of correlations are about the same. (From ± .06 to ± .08). A more detailed study of the figures for incidental and direct memory in the same tests gives the following correlations.

Correlations Between Direct and Incidental Memory Parts of the Same Experiment

	r	P.E.
Colors (direct) with Incidental	+.34	±.07
Letters (direct) with Incidental	+.37	±.07
Paragraph (direct) with Incidental	+.18	±.08
Magazine (direct) with Incidental	+.14	±.08

Average r = +.275
Median r = +.26

Note: In the Colors and Letters test the same material was used for the direct as for the incidental memory, while in the other two tests, the comparison was made between the two parts of the *same* experiment, the material used, however, being different.

Additional Experiments
Colors and Forms Test

		r	P.E.
Group 1	Forms direct with Colors incidental	r +.14	.08
2	Colors direct with Forms incidental	+.11	.10
3	Forms direct with (Forms of Colors) incidental	+.46	.087
	Colors direct with Colors of Forms incidental	+.23	.10

Magazine Test. Series II I

Group 1	Names Direct, Pictures Incidental	+.43	.10
2	Names Incidental, Pictures Direct	−.28	.11
	Average r +.275		
	Median r +.255		

Although these additional experiments differed greatly from the original ones in their presentations and even somewhat in material, it is interesting to note how closely the average and median correlations compare in the two sets. This second set then, serves as a check on the first.

Conclusions:

Individuals who have good memories for learned material are more likely than not to have good incidental memory, although the correlation is low. The relation between incidental memory and direct memory in general, is closer than between incidental memory of two different kinds of material or between the direct memory of two different kinds of material. Incidental and direct memory for two parts of the same experiment correlates more highly than direct memory parts of two different experiments.

The fact that the correlation though positive, is low is of significance and will be discussed in the final chapter of this paper where the question of the practical application of the results of the present work will be considered.

Note: The correlation of the averages is somewhat higher than the average correlation here of several tests, (.34 and compared with .275). This is to be expected, first because in computing the correlation of the averages, all of the scores were lumped together, while in the average of the correlations the correlations were made only between direct and incidental memory of the *same* experiment. And in the second place there is greater chance variation in computing correlation of averages, and this tends to raise the coefficient of correlation.

CHAPTER VI

The Relation Between Recall and Recognition of Incidental Material

The relation between recall and recognition has been carefully worked out by E. M. Achilles (1) for direct memory. She found a low positive correlation, and a low correlation between the recognition of different materials. In connection with her experiments she compared recall and recognition of subjects when they knew they would be asked for material presented and when they were ignorant of the purpose of the presentation, in other words, direct and incidental memory. She found that "the difference between recall and recognition is greater when the subjects did not know that their memory was to be tested than when they did know."

Prof. Hollingworth found (14) that the "will to learn" does not make as much difference in recognition as in recall. This would account for the above statement by E. M. Achilles.

As a side problem to the general subject of Incidental Memory, a comparison was made of recall and recognition of incidental and direct material. The following tables give a summary of the results. The question to be answered is: Do the results substantiate or disagree with the results found by E. M. Achilles? In other words, what is the relation between the recall and recognition of incidental material? 2. Do individuals vary as much in their ability to recognize incidental material as in their ability to recall it?

TABLE VII

Relation Between Recall and Recognition for Both Direct and Incidental Memory

Direct Memory	
Magazine Part A. Recall with recognition	r + .46
Paragraph Part A. Recall with recognition	r + .29
Average r + .375	
Median r + .375	
Incidental Memory	
Letters. Recall with recognition	r + .43
Colors. Recall with recognition	+ .47
Magazine C. Recall with recognition (Series I)	+ .63
Paragraph B. Recall with recognition	+ .53
Paragraph C. Recall with recognition	+ .38
Average r + .488	
Median r + .470	

Since only two tests were given in which direct recall and recognition could be correlated, there is not enough basis to draw any conclusions as to whether or not there is a higher correlation between recall and recognition when applied to direct memory material or incidental memory material. It is quite possible that had several more experiments been given in such a way that this comparison could be made, the average correlation between recall and recognition for direct memory may have been raised so that the difference was even less than it appears here.

In comparing the above correlations with those for the recall of various kinds of incidental and direct material, we find the coefficients of correlation consistently higher for recall and recognition. It would seem to indicate that there is a closer connection between recall and recognition of the same material, than between the recall of direct and incidental material. These results are in line with those found by E. M. Achilles although the problem has been approached from a different angle.

There is, however, a factor here which would influence any generalization which might be drawn from such a statement. The comparison of recall and recognition in any given experiment was always for the *same* material, while in the case of recall, the material for incidental memory was not the same in most cases as that for direct memory.

It is interesting to note in the table that the highest correlation is that between recall and recognition of the pictures of the magazines.

Chart IV shows the relation between recall and recognition for two parts (A and B) of the Paragraph test. On the whole recognition is better than recall.

The greater variability for recognition of the typographical errors (Part C) over the content of the paragraph (Part A) is evident. Recognition of typographical errors was poorer than recognition of the direct memory material which had to do with the description of Savanarola or the incidental material concerning the general background.

It would have been interesting to compare the recall of incidental material with the recognition of direct memory material. Unfortunately the comparison cannot be made, for it would involve scores of both recognition and recall on the *same* material when presented both as incidental material and

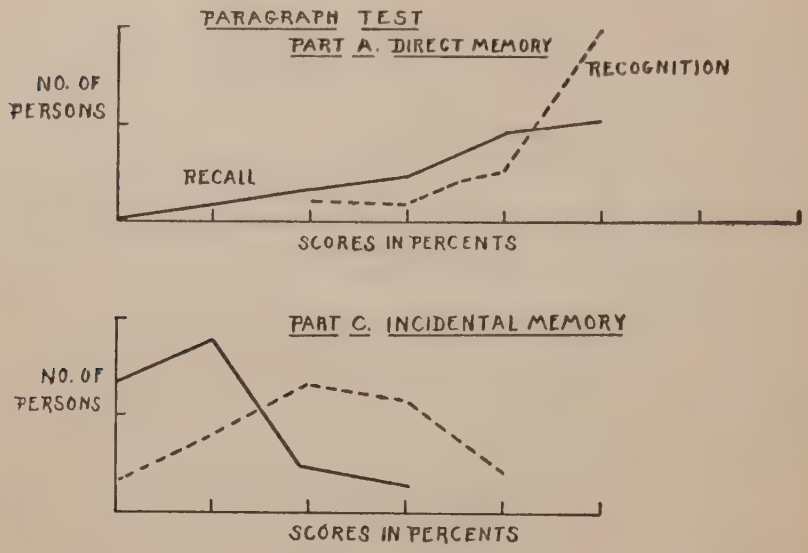

Chart IV—Relation between Recall and Recognition

as direct material. None of the experiments were planned to bring out this point and consequently, the figures for such a comparison are not available.

CHAPTER VII

A Comparison of the Results of the Incidental Memory Experiments with the Results of a Group of Experiments from Poffenberger's Manual

The subjects for this study were chosen from a class in Experimental Psychology. Sixteen subjects were used. The experiments from Poffenberger's Manual were carried on with the regular work in Experimental Psychology and supervised by the instructor of the course. Results of the following experiments were considered:

VI. Memory Span. Digits, letters, nonsense syllables, words.

VII. Relations Between Quantity of Material and Learning Time.

IX. Efficiency of Recall and Recognition. Retained members score.

XII. Saving Method for Recall. Per cent saved. Nonsense material.

XV. Memory for Names and Faces. Trials and errors.

XXVI. Reaction Time to Light.

XXXV. Range of Visual Perception (quantity) Digits, letters, unrelated words, phrases.

The numbers refer to the numbers of the experiments in the Manual.

The above experiments were selected for two reasons: first, because they seemed to the writer to be related to the problem in hand, and secondly (the real determining factor) because these had been completed by the subjects when this study was made.

Only two incidental memory tests could be given to this group. The two selected were the Colors and Letters test and the Paragraph test.

TABLE VIII

CORRELATIONS BETWEEN INCIDENTAL MEMORY TESTS AND EXPERIMENTS FROM POFFENBERGER'S MANUAL

	VI			VII		IX	XII	XV	XVI	XXXV		
Fig.	Letters	N.S.	Words	8 Syl.	12 Syl.	Reta'd m'bers	N.S.	N'ms Faces	Reac'n to L'gt	Letters	Words	Phrases
Colors	+.41	−.03	−.17	+.28	−.47	−.115	+.16	+.26	−.36	−.65	+.28	+.47	−.24
Letters	+.36	+.11	+.03	+.40	+.48	+.35	+.19	−.05	−.33	−.13	+.27	+.42	−.16
Paragr.	−.10	+.16	+.37	−.24	−.34	+.26	+.16	+.38	+.09	+.37	+.13	+.63	+.40
Par. C.	−.18	+.39	+.33	−.39	+.25	+.51	−.116	+.64	+.45	−.115	−.08	+.36	+.25

The scores used for the above correlations of the Poffenberger Experiments were as follows:

VI. Memory Span. Number of digits, letters, nonsense syllables and words recalled by the subject, reproduced immediately after material was presented. Only one presentation was given.

VII. Here the score taken was the time required to learn the 8 syllables and the 12 syllables. A positive correlation then would mean that the shorter the time required to learn the syllables, the better the incidental memory.

XI. Recall by the method of retained members. The score equals the number of words immediatey recalled after one presentation.

XV. Memory for Names and Faces. Score equals the number of trials for one perfect recall on the first day (the same day the experiment was given). This score was taken because in the incidental memory tests the recall was always given on the same day.

XII. Saving Method. Score equals the per cent of saving after an interval of twenty minutes (to correspond with interval of incidental memory tests).

XVI. Reaction Time to Light. Here a positive correlation would indicate that the shorter the reaction time, the better the incidental memory.

XXXV. Range of Visual Perception: Quantity. Here a positive correlation would mean that the more words, phrases or letters perceived at once, the better the incidental memory.

The correlations of Table VII are for the most part very low, and because of the few subjects, the reliability is low. There are a few correlations however, which are so high that it seems hardly possible that they could be accidental, since they exceed .50. They are:

+ .64 between the amount of material saved (XII) and the ability to remember such details as typographical errors, misspelled words, etc. (paragraph C).

− .65 (The highest correlation of all) for reaction time to light and the ability to remember colors.

+ .63 for range of perception of words (XXXV) and incidental memory of material related to the problem of description. (Paragraph B).

+ .51 for incidental memory of details of paragraph and time required to learn 12 syllables.

The most consistent set of correlations are those for range of perception of words and incidental memory for colors, letters, paragraph B and C. This is significant especially since the lowest plus correlation in this group is .36. It would seem to indicate that there is an interdependence between the range of perception and incidental memory. This one fact alone was worth the analysis and suggests that it might be well worth while to follow through this hint in some more detailed experiments, for if one could increase one's incidental memory by increasing one's range of perception, using regular practice methods, much could be gained.

Another suggestive result worth following out, is the close interrelation between reaction time to light and the incidental memory for colors. The minus correlation is contrary to expectations because it means that the longer the reaction time, the better were the colors recalled. The colors were exposed to all an equal time, namely, 3 minutes, ample time to eliminate the advantage gained by those whose reaction time to light was quicker than the others, and evidently those who reacted more slowly to light retained more vivid impressions of the colors. Certainly the problem of reaction time may still throw much light on the more complex mental processes.

Conclusions:

The above correlations do not give us much assistance in analyzing the complex problem of incidental memory into its simpler components. Perhaps other experiments might have yielded better results, but these were the only ones available which seemed to have any connection with the problem in hand. The correlations for the most part were low, sometimes negative and sometimes positive, varying with the different kind of material used. The two experiments, however, which

yielded the most suggestive results were the experiment on reaction time to light and the range of visual perception for words.

In the reaction time to light experiment a high minus correlation was found between reaction to light and incidental memory for colors, the other correlations were low and fluctuating.

In the range of visual perception we have consistently plus correlations, none of which fall below .36, and point to the fact that a person's range of visual perception largely determines how much incidental material she will remember. Attention has always been known to be an intimate factor in memory, but range of visual perception is one step back of attention, for it shows the limitations of attention due to the constitution of the individual. Here at least is one step in the analysis of incidental memory. It is beyond the scope of this paper to delve further into the analysis....such a piece of work would furnish material enough for several studies, but it is interesting to have the way indicated by these figures even though they are based on the results of only fifteen subjects.

CHAPTER VIII

Analysis of Introspections of Subjects for Colors and Letters Test and Paragraph Test

The same group of subjects was used for this study as for the preceding one, in fact, immediately after they had finished the work of the experiments these students were asked to write their introspections, giving whatever light they could on the reason for their remembering or failing to remember the material called for in the incidental memory parts of the experiments. The students were all Juniors or Seniors who had had some training in giving introspective reports, and since their introspections are very simple and were given immediately after the experiment they are sufficiently reliable to indicate aids or hindrances in remembering the incidental material. A digest of the introspections of each of the fifteen subjects together with their scores on the Colors and Letters test follows. The first score is for the colors, and the second for the letters. The highest possible score for each is 10.

Subject 1. "I remembered the triangle being gray and having the letter N *because it was the first on my list.* I remembered the color of the circle *because it was the first on the cardboard.* I remembered the color of the square and the oblong *because I debated a while as to which was longer.* I remembered the color of the black *because it stood out so blackly."* Score 8-6.

Subject 2. "B, I remembered it *because it was the smallest.* C and A, I remembered as belonging to the square and the diamond *because I had changed them around. The colors were harder to remember than the letters because I had entirely ignored them* at first and very few left any impression. *Recognition of colors* was easier than that of letters....recall of letters easier than that of colors." Score 4-3, (although she states that recall of letters was easier than that of colors her score for colors is higher than her score for letters).

Subject 3. *"The figures that I puzzled over longest I remembered best both in regard to color and letter. Striking*

colors or especially colors that I like I remembered best, as for example, robins-egg blue and the circle. *Position,* the figure that I put first, for instance helped me to remember it." Score: 4-5.

Subject 4. "I remembered *C and N* and S and T *because I had a hard time judging the size of the two.* I remember when I saw the chart I said, 'there are all colors' and I noticed the circle was a greenish blue. One thing that helped me was remembering the size of the figure and the place in the column of Part 1 (judgment as to size) that the letter was, the circle was the largest and the first letter was T. Score: 9-7.

Subject 5. "I didn't pay much attention to letters and colors in Part I so my recall in part II was rather *poor particularly for letters* but I *could call up a visual image of the figures with their colors without much trouble.* In part I, I started my list off with S.O.T. so those letters were not hard to remember. The others were quite confused in my mind except for N" (no reason given). Score 9-6.

Subject 6. "I remembered the *colors more easily than* the letters." Score: 7-5.

Subject 7. "I found remembering the letters with the colors the most difficult, I think probably because the letters were very subordinate to my main idea when I first saw the chart. In Part IV (Recognition) I placed the letters by eliminating the ones I was sure of and guessing at the rest." Score: 7-2.

Subject 8. "I could *not decide between P and S as to which was the largest,* for this reason I remembered their colors and letters best. *All the colors were easy* to recall but the letters were difficult because I scarcely glanced at them but attended entirely to the figures themselves, comparing their size and only in the two above mentioned cases was I really ever conscious of the letters." Score: 9-6.

Subject 9. "Some of the figures I was able to remember; the square, the star, the cross, the pyramid, and the diamond ....with these I remembered the colors. *I have a visual image of the card with the figures plainest on the ends. The letters were much harder to remember,* with a few I *formed these associations,* B (or P green) A is square; N B (or pyramids) (?) O. orange. Score: 7-3.

Subject 10. *"Orange had O, same letter as the beginning of the word,* remembered it that way. In general it was *harder*

to remember the paler colors and the letter which went with them than the more intense shades. Score: 7-6.

Subject 11. *"I seemed to feel a tendency toward green both in recall and recognition,* especially the latter. In every case where a green figure was shown (in recognition) I had to resist the tendency to think that was the right one. *My means of* recall *and recognition both seemed to be to visualize the different possibilities together until I got one that seemed familiar."* Score: 5-2.

Subject 12. *"I remembered the cross as black.* With this figure I associated the letter D, and with the square A, the two I recalled as D, A. *The rectangle I remembered because of its striking color* and the letter because it was the first of the color—O....Orange. Score 8-9.

Subject 13. "I had no particularly strong visual impression when the card for recognition was shown. *Certain figures had been strongly impressed as the black cross and the green star.* Letters seemed harder than colors to recall or recognize probably because little attention had been paid to them before. Score: 6-5.

Subject 14. "For the most part I was unaware of the letters and had much greater difficulty trying to recall them than the colors. F, which was under the circle I remembered because it was first on the list and I noticed it particularly. I said the half circle was pink so I called it this when I saw the four colors in recognition, *although my natural impulse was to recognize the blue (which would have been correct) but I finally said pink because this false visual image kept returning.* Score: 3-0.

One subject neglected to record any introspections.

No student of memory would find anything new in the above introspections. The causes for remembering certain things can be grouped under the same categories as has been the rule in other memory studies. The one fact, of course, which stands out very plainly is that many of the subjects attribute their inability to remember, especially the letters, to inattention, and yet they must have seen the letters for they wrote them down in the first part of the experiment as indicating certain of the figures. In fact their attention was directed to the letters more directly than to the colors about which nothing was said in the directions. A summary of the factors

brought out will present the above material in a more precise form.

Success in remembering incidental material was attributed to—

1. *Association by position.* Many of the subjects remembered the position of the figures on the cards *especially at the ends,* others remembered the figures which they had placed first in their list, recalling both the colors and letters of these.

2. *Association by analysis.* Under this head would include those subjects who remembered that orange color went with the letter O because they remembered that O was the first letter of the color of that figure; B or P green—rather a stretch but still enough to serve as a connecting link.

3. *Influence of intensity.* The bright yellow was remembered and the orange because it was a "striking color." The black cross also may be included under this heading.

4. *Personal idiosyncrasies.* Remembering the color one likes best.

5. *Ability to visualize the card and recall the colors and letters through visual imagery.*

Failures to recall material are attributed to:

1. *Inattention,* because the subject was occupied by another problem.

2. *Personal idiosyncracies* such as having a "tendency to call everything green," and "the wrong visual image" appearing and being chosen in spite of a definite feeling of familiarity with another color. Difficulty in remembering paler colors.

Individual differences here were great even in so small a group. Some subjects found one color striking or easy to remember while other subjects had quite different experiences. Had more detailed introspections been taken from better trained subjects undoubtedly a real reason would have been found for the remembering of each bit of incidental material, but the reasons would quite probably all have fallen under one of the above four groups. These are the obvious factors of incidental memory. The more fundamental factors would have to be revealed by some such study as that indicated in the preceding chapter.

Introspections for the Paragraph Test

The introspections given by the subjects on this test were very scant and consisted for the most part in stating that they

did not remember the details of the passage because they believed they were to be questioned entirely upon the description of Savanarola. A few tried to account for their success in remembering the incidental material.

"The details of the account were easy to recall because I gave each detail special attention as I read it over the first time."

"I remembered 'Domincan' because I always have trouble pronouncing the word and I looked to pronounce it from the spelling and noticed that it was wrong."

This was the last test given to the large group of 77 subjects. The experimenters in order to make sure that the students were not aware that the test was for incidental memory at the end of the experiment asked each student to write at the bottom of her paper whether or not she suspected that this was an incidental memory experiment. Several of the subjects did suspect, but on being questioned later said they had no idea as to what kind of questions would be asked, they were just alert for possibilities. A comparison was made of the scores of those who suspected with those who did not suspect. The results follow:

Out of a group of seventy-five subjects, 36 suspected that they would be asked for material other than the description of Savanarola and 39 did not suspect. The averages for the three parts of the paragraph test for these two groups are:

	Av. Part A.	Av. Part B.	Av. Part C.
Suspected	17.3	11.7	7.2 (No. 36)
Did not Suspect	16.9	11.8	6.6 (No. 39)

These averages are so close that there is practically no reason to believe that even though they did suspect that they would be asked for other material, the results were influenced. There is in no case even a single whole point difference in the averages. So that the general state of alertness does not appear to have given much advantage to the group who suspected that they would be questioned on incidental material.

Compare these averages with those of a group of 27 who were given the entire paragraph test as a direct memory test, the questions which they would have to answer being read to them beforehand.

PARAGRAPH TEST

	Av. Part A.	Av. Part B.	Av. Part C.
Suspected	17.3	11.7	7.2
Not Suspected	16.9	11.8	6.6
Direct Memory	14.8	14.5	11.3

For the direct memory experiment, the attention was undoubtedly more scattered, due to the fact that the subjects knew they must try to remember a larger amount of material, and consequently, the first part which was the real direct memory part for the other groups lost several points in its average and the other two parts gained perceptibly. Here the subjects knew specifically what material would be called for which had a great advantage over simply being on the look-out for incidental material in general.

Conclusions

The importance of attention, which has been brought out in so many of the introspective reports, is all too obvious to deserve comment. It is not the failure to recall incidental material which needs to be accounted for so much as the ability to recall any of it at all. There is no common denominator which will determine what material presented as incidental material to a group, will be recalled, for in each case it is a personal equation depending upon the past experiences and the interests of the individual. For direct memory certain predictions can be made as to the likelihood of material being recalled depending upon the amount of time and energy spent in learning, and of course, also upon the ability of the individual to memorize. But differences in direct memory are usually reduced to quantity of material recalled. In incidental memory the particular piece of material recalled is even more important since with only one presentation of material not directly attended to for the purpose of recall, the likelihood of any item being remembered is directly dependent upon each person's mental content at the time.

Forms with their colors were more easily remembered than forms with their letters. The laws of vividness which hold true for direct memory hold true quite as well for incidental memory.

Position is a large factor especially when subjects tend to visualize the material presented in order to recall it.

In general a state of general alertness which comes from suspicion that they were going to be asked for incidental material did not give those subjects advantage over the ones who concentrated on the main problem, and did not suspect that other questions would be asked.

CHAPTER IX

Summary and Conclusions

In spite of all the work which has been done here and abroad on the so-called "Psychology of Testimony" which aimed to discover fundamental facts about incidental memory, the surface of the problem had hardly been scratched. Its importance as having direct bearing on our every-day life is evident by the amount of energy and number of pages written about it, and yet the problem itself is just beginning to take on definite form. The present study, it is hoped may serve to suggest new trails to be followed. The results of this study may be summarized briefly as follows:

I. *Variability of Incidental Memory Within a Group:*

1. Individuals differ widely from each other in their incidental memory.

2. Individuals vary in their differences according to the kind of material used.

3. The greatest variability was found for the incidental memory of numbers.

4. Individuals on the whole vary less for direct memory than for incidental memory. The smallest variability was found in reproducing memorized material (Magazine test) in the order given.

5. Disconnected material, such as letters and numbers, and the typographical errors and misspelled words had the lowest averages in incidental memory. Therefore, it is easier to recall incidental material which was closely connected with the matter to which the primary attention had been paid than to recall material which does not directly influence the problem in hand.

II. *Differences Within the Individual*

1. Individuals are not necessarily consistent in their ability to recall incidental material. Their success depends upon the

kind of material presented. On the whole, however, the correlations were positive though low.* An individual may recall specific kinds of material exceedingly well but does not necessarily show a good incidental memory for all kinds of material.

III. *The Relation between Incidental and Direct Memory*

1. The correlation between incidental memory (averaged for all the tests) and direct memory (averaged) is closer than that between incidental memory for one kind of material and incidental memory for a different material.

2. Incidental and direct memory parts of the same experiment correlate more highly than the direct memory parts for two different experiments, or than two incidental memory experiments. In other words, material is more differentiating than the kind of memory used.

IV. *The Relation between Recall and Recognition in Incidental Memory*

1. There is a higher correlation between recall and recognition for incidental memory than for direct memory.

2. The correlations between recognition and recall either for direct or incidental memory of different material are higher than the correlations between the recall results of two different tests for either incidental memory or direct memory. People who recall incidental material well, are also likely to recognize it well.

V. *Analysis of Incidental Memory according to Correlations between Incidental Memory Tests and Experiments from Poffenberger's Manual*

1. Most of the experiments gave small positive or negative correlations with the incidental memory test. This does not mean, however, that it is useless to explore this field further. Intensive work needs to be done along this line.

2. The most suggestive results were those for the experiments of range of visual perception, and reaction time to light. The correlations in these two cases were high (over $-.60$ for

*These figures, of course, cannot be considered as final since the groups for this part of the study were limited to college students only. This limitation in selection of subjects would tend to lower the correlations, somewhat.

light, and averaging over + .45 for range of visual perception) and they indicate a definite relationship between incidental memory and the reaction time to light (in the case of incidental memory for colors) and range of visual perception for all of the incidental memory tests.

VI. *Analysis of Introspections*

1. Since the subjects were not aware that they were to be asked to recall the incidental material no devices could be consciously used to remember it, and yet certain bits of the material were retained because of associations made which were very like the associations which are made consciously for direct memory experiments.

2. Those associations which helped to bring the incidental memory to mind were:

The position of the figure (in color and letters test).

The vividness of the colors.

The affectability of the subject for certain colors.

The order of the list which the subject made out.

Personal idiosyncrasies which made it easy to recall certain kinds of material.

3. Failures to recall the incidental material were attributed to:

Inattention, or the fact that the attention was absorbed by the main problem in hand.

Personal idiosyncrasies which influenced the subject toward certain constant errors.

4. The fact that part of the subjects suspected that incidental material would be asked for in the latter part of the test did not give them advantage over those who entertained no such suspicions. The averages for the two groups were about the same.

5. The averages for the direct memory of the incidental material were much higher than for incidental memory even though the subjects suspected they would be questioned later on concerning the latter.

Discussion

In the foregoing piece of work the writer has attempted to simplify incidental memory experiments and to indicate along what lines further study would be profitable.

The practical need for information about incidental memory is great, for our incidental memory plays a great part in

our every-day life, and he who is endowed with a mind which retains impressions once presented and is able to recall them at will, has a great advantage over his fellow being whose memory is like a sieve and needs repetition and direct attention for material to be at hand when needed. Whether or not incidental memory can be developed or improved depends upon its constituent elements and their educability. Dallenbach (10) has shown the improvability of memory due to short daily drills. If incidental memory depends upon attention span or range of perception, and these can be improved, undoubtedly, incidental memory can also be improved and drills toward that end will be a valuable addition to a school curriculum.

If incidental memory is entirely dependent upon interest, and direct attention, then its improvability is more difficult and complex. However, exercises in seeing how many things one can remember as one passes along the street, etc., might well help to form the habit of paying attention to a larger number and variety of the things with which one comes in contact, and the necessity for reporting them correctly lead to accuracy as well and quantity of observation.

From the above study, we see that the individual varies greatly in the kind of material he can remember, and that there is always a reason for his remembering whatever incidental material he can recall. Incidental memory is only "capricious" when we do not know its determining factors, but once these are analyzed and the laws governing them formulated by experimental research, we find incidental memory as logical and as inevitable as the better accredited form of direct memory.

They are alike in that fixation depends on some response. In direct memory the response is directed from the outset by the task, in incidental memory the response is not so directed, but occurs because of such factors as intensity of the stimulus, or habitual interest.

Incidental memory could be defined then as the memory of those facts which had come within the range of the attention while the attention was being directed toward some other facts and which had become fixated because their own intensity was sufficient to cause fixation, or because they had in some way become linked up with the individual's habitual interests and past experience, and had become incorporated with them.

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